

Master thesis for the Master of Philosophy in Economics degree

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# Offshoring in the Norwegian industry

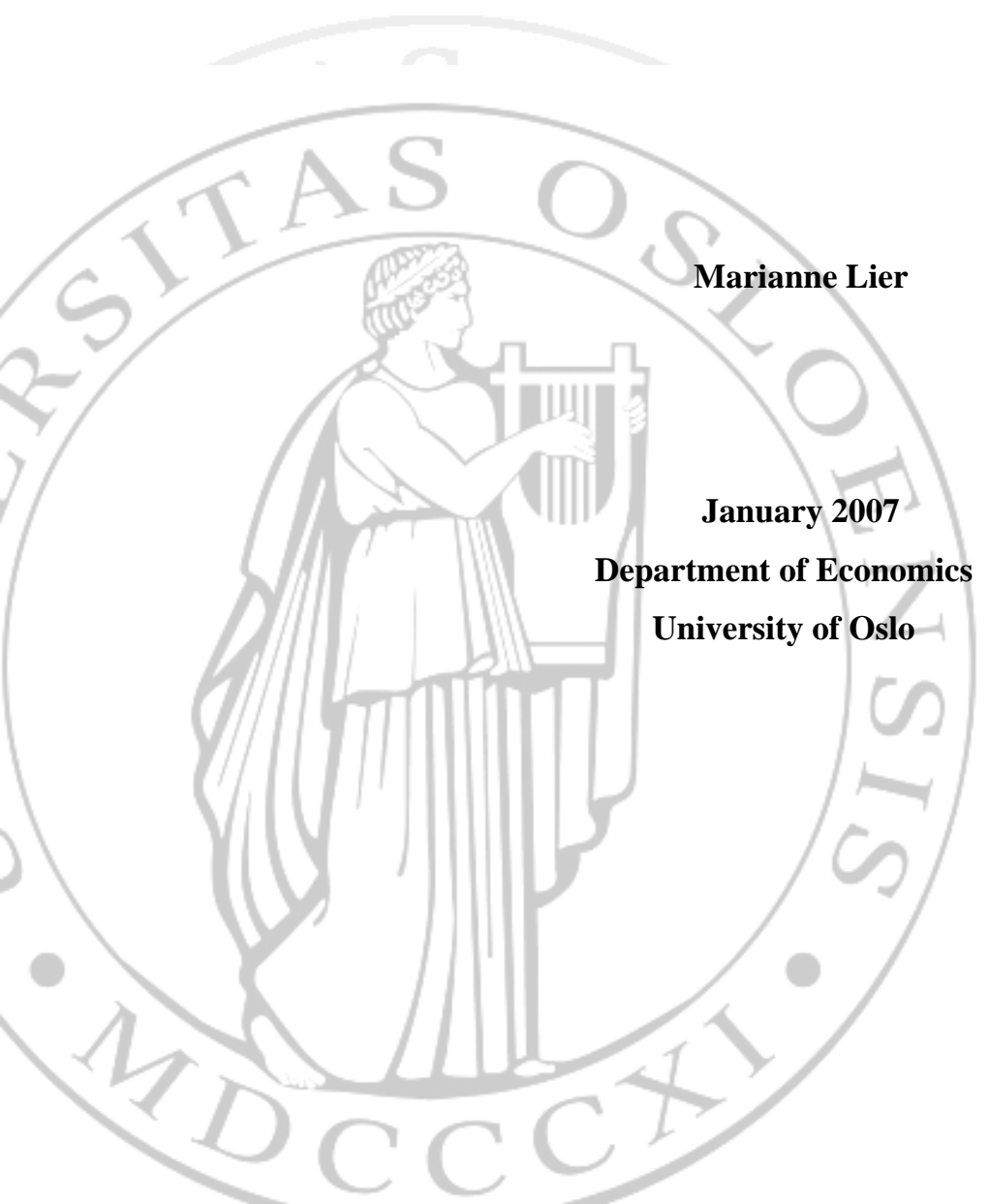
*International Relocation of Production Processes:  
Industry and Firm Determinants.*

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**January 2007**

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## **PREFACE**

It has been an interesting and instructive process to write this thesis. The overwhelming amount of information has made it challenging to structure the material, and could not be done without the help from my proficient supervisor Karen Helene Ulltveit-Moe.

I would like to thank Knut R. Skotner and Knut E. Sunde in Federations of Norwegian Industries and Per Heum and Frode Kristiansen in Institute for Research in Economics and Business Administration for giving me access to necessary data and information. I truly appreciate their assistance.

I will also like to thank all the people that have supported and encouraged me through this process. All amendments and advices have been of value.

*Oslo, January 28<sup>th</sup>*  
*Marianne Lier*

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## SUMMARY

The aim of this thesis is to analyse the determinants that trigger Norwegian firms to offshore and to examine how firms and industries choose to organize their vertical activities; through in-house offshoring or outsourcing. The determinants that trigger the Norwegian firms to offshore production may be examined by analysing the cost trade-off associated with splitting production activities by function.

Surveying the determinants for offshoring in the Norwegian industry is important for understanding the increasing verticality in trade, and it can be a starting point of an analysis of the consequences offshoring will have for the Norwegian economy.

The forces of globalization are believed to have changed the nature of trade, leading to an increasing interconnectedness of production processes where countries specialize in stages of production and vertical trading chains are created across boundaries. Globalization reflects the many technological and organizational developments that have made it easier to carry out international transactions. Furthermore the opening of the markets in China, India and Eastern Europe give access to different factor endowments, technologies and to a huge pool of non-agricultural labour. Technological advance in logistic processes which improve timeliness and reduce time- and co-ordination costs, in addition to the diffusion of information technologies, has improved the utilization of these markets.

Fragmentation of production processes allows for a more specialized use of factors in production. Specialized production blocks can be relocated to countries which are relatively abundant in the factor that is used relatively more of in the production process. This enables a lower marginal cost of production. The relocation of production processes has its costs in terms of increased trade and transportation costs, but also due to an increased need to co-ordinate intermediate goods that requires timeliness and efficient transportation. In addition, frictions in market due to imperfect information may increase the costs of finding a partner to form a relationship with, the costs of (re-) negotiating contracts, and the hold-up problem leads to insufficient investments. This trade-off is important for gaining insight into

the determinants that trigger Norwegian firms to offshore production. I will use variants of standard trade theories, such as Ricardian model of trade and Heckscher-Ohlin to explain how benefits arises from differences in technology and factor endowments. The costs of disintegration will be examined by reviewing Jones and Kierzkowski's (2000) model of co-ordination costs and transaction costs.

The organizational form is chosen to reduce the transaction costs, and the boundaries of the firm are assumed to be determined where the costs of using the market to allocate resources are the same as the costs of keeping the activities internal in a firm. I will use Dunning's OLI framework and asset specificity theories to gain insight into the choice of organizational form.

I have used data from a survey conducted by TBL<sup>1</sup> which examines the offshoring activity among the companies in the Norwegian technology industry. These data are combined with financial data from the Dun & Bradstreet database. The calculations have been conducted by the use of SPSS 14.0 and Microsoft Office Excel.

The findings, using descriptive analysis, support that the main reason for firms to offshore is to save costs. As the costs of unskilled labour in Norway are relatively high, many firms relocate their activity to countries abundant in labour such as China and countries in Eastern Europe. These areas represent also emerging economies, where Norwegian firms see a potential market for their products. Some firms report this as a reason for their offshoring activity, but often in combination with the desire of saving costs.

Transaction costs are assumed to be increasing relative to the size if the firms are small. The analysis shows that large firms do have a high share of offshoring, but so do the smaller firms in our sample. Also the geographical relocation cost is assumed to be higher with distance, and as smaller firms have relatively smaller volume in their transactions than larger corporations we may expect that the fixed costs of offshoring are relatively high for a small firm. Surprisingly, the smaller firms in our sample have high shares of offshoring to Asian countries.

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<sup>1</sup> Teknologibedriftenes landsforening

Theory predicts that the choice of organizational form depends on the transaction costs that a specific firm or industry faces, and that the relative ability to undertake different organizational forms depend on a firm's productivity. Most of the firms in our sample use the market to allocate resources, and consistent with theory, these firms are less capital intensive and have less productivity than firms that choose to use in-house offshoring.



## 1.0

### THE DETERMINANTS OF OFFSHORING

#### 1.1 BACKGROUND: GLOBALIZATION AND REALIGNMENT OF PRODUCTION PATTERNS

Globalization is a complex concept, an intertwined system of processes and structural shifts that leads national and local markets into a single global market, and that affects how businesses and societies are organized. The term has been used since the beginning of the 1980s, reflecting the many technological and organizational developments that have made it easier to carry out international transactions. As noted by Burda and Dluhosch (2002): *"We are witnessing a wave of fundamental developments which are changing ways that nations interact economically with each other. Mega-mergers and cross-border firm linkages have intensified trade in intermediate good. An especially impressive development has been the rise in outsourcing, which allows firms to extend activities across national borders and tailor manufacturing strategies to idiosyncratic attributes of local production sites"* (pg 2). In this section I will go through some of the changes that have made it possible to relocate production processes across borders and that facilitate trade.

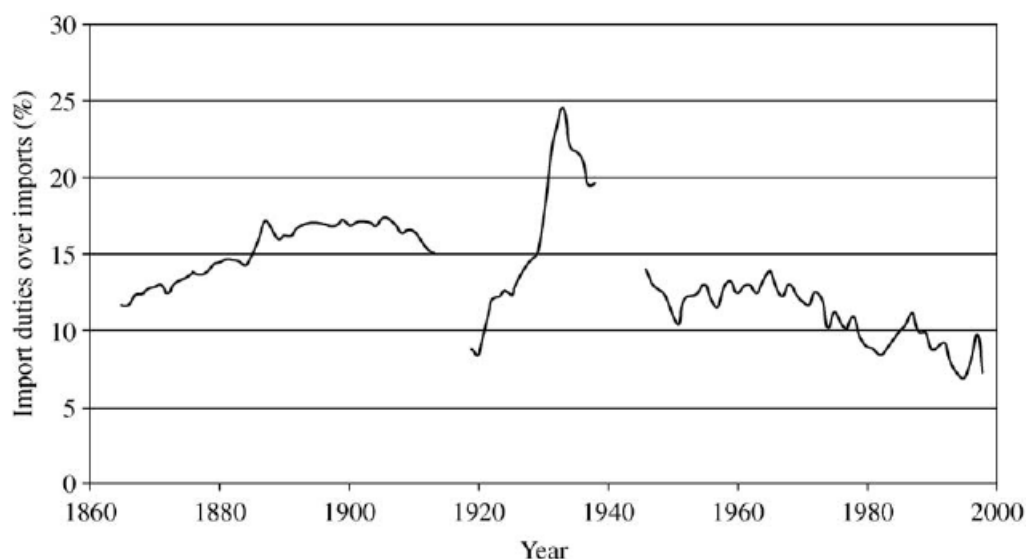
The opening of the markets in China and India has been of great importance for access to different factor endowments, technologies and to a huge pool of non-agricultural labour<sup>2</sup>. This creates challenges for many countries in the world since the competition increases when markets get more integrated, but also possibilities in terms of new customers and potential cost savings, exploiting differences in comparative advantages. Also, according to Friedman (2006), the fall of the Berlin Wall 9<sup>th</sup> of November 1989 was one of the forces that "flattened the world", as the Soviet Empire now opened for democratic and free-market oriented governance and "liberated all the captive peoples of the Soviet Empire" (pg. 51).

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<sup>2</sup> Since 1995 around 700 million workers have been added to the non-agricultural labour force, and around 1.5 billion extra workers are expected to join in during the next 30 years. See European Commission (2006), "Globalisation: Trends, Issues and Macro Implications for the EU" pg. 12 See European Commission (2006), "Globalisation: Trends, Issues and Macro Implications for the EU" pg. 12

Changes in laws and (global) institutions such as World Trade Organization, European Union and International Monetary Fund have made it easier and less costly to accomplish transactions (i.e. commodities, labour, services or capital) across borders as tariffs have decreased. Graph 1.1 shows the reduction in the average world tariffs over time. Messerlin (2001) shows standard trade weighted and arithmetic averages of tariffs over a wide range of countries and sectors. The findings for the arithmetic average of tariff barriers over sectors for the European Union in 1999 was 31.7% in agriculture, 22.1% in textiles, 30.6% in apparel and much less in other industrial goods. These numbers are quite high, and as Anderson states: “Trade costs are large, even in the absence of formal barriers to trade and even between apparently highly integrated economies” (Anderson, 2005)

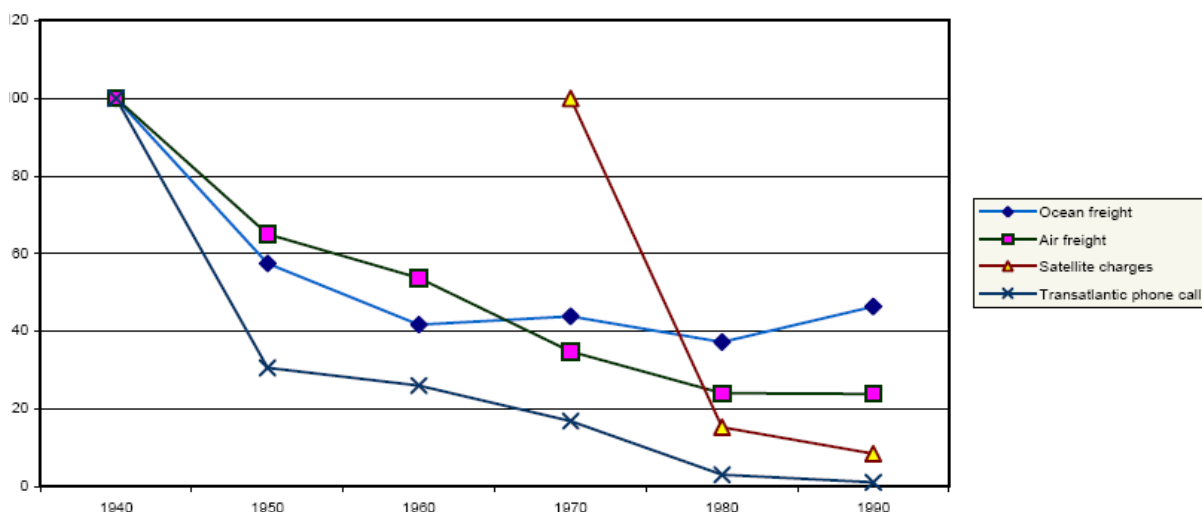
**FIGURE 1.1 DEVELOPMENT OF UN-WEIGHTED AVERAGE TARIFF, 1860-2000**



**Notes:** Un-weighted world average own tariff, 35 countries

**Source:** Clemens and Williamson (2004), “Why did the Tariff-Growth Correlation Change after 1950?”

Another important feature is the reduction in transportation and communication costs, which makes it less costly to trade goods across borders. Graph 1.2 gives us an indication on the development of physical transportation costs, satellite charges and transatlantic phone calls.

**FIGURE 1.2 TRANSPORTATION VERSUS COMMUNICATION COSTS, 1940- 1990**

Source: Baldwin (1999), "Two Waves of Globalization: Superficial Similarities and Fundamental Differences"

In addition to physical transportation costs, co-ordination costs, time costs and indirect transportation costs<sup>3</sup>, such as the storage and holding of goods in transit, inventory costs due to buffering the variability of delivery dates, preparation costs associated with shipment size, etc, also matter. Harrigan and Venables (2004) emphasize time costs and how these differ from direct monetary costs because of uncertainty. In many cases the final production of a good is dependent on different imported components, and uncertain arrival time of components will lead to a cost that is higher than expected for a single component. Demand- and cost uncertainty makes it profitable to postpone production until uncertainty is reduced as much as possible, but if the physical distance between stages of production and selling is long, then ordering components would in many cases be done before this uncertainty is resolved. Thus, even if physical trade costs and tariffs have not decreased too much, time costs, better timeliness, co-ordination and small product cycles, can be an additional explanation for the increase in vertical trade.

Graph 1.2 does not incorporate the spread of global network of individuals and firms linked by information communication technologies (ICT). ICTs, such as micro-computers and the internet allow transmission of messages and images all over the world, allowing for a higher degree of diffusion of information, technology and

<sup>3</sup> European Conference of Ministers of Transport OECD (2004)

standards. This new technology makes distance and physical space less important and has “fundamentally altered the scope (widening the reach of networks of social activity and power), intensity (regularized connections), velocity (speeding up interactions and processes), and impact (local impacts global) of transformations”. (Blossfeld et al., 2005, pg. 4)

The forces of globalization, some outlined above, are believed to have changed the nature of trade, leading to an increasing interconnectedness of production processes where countries specialize in stages of production and vertical trading chains are created across boundaries. The production of a Barbie doll describes the features of global production quite well: *“The doll is designed in Mattel’s headquarters in El Segundo, California. Oil is refined into ethylene in Taiwan and formed into plastic pellets that are used to produce the doll’s body. Barbie’s nylon hair is manufactured in Japan, while the cotton cloth for her clothing originates in China. The moulds for the doll are made in the United States, as are the paints used to decorate it, and the cardboard used for packaging. Assembly takes place in Indonesia and Malaysia. Finally, the dolls are quality tested in California, and marketed from there and elsewhere around the globe”<sup>4</sup>.*

## 1.2 APPROACH: THE DETERMINANTS OF OFFSHORING

### 1.2.1 Definitions and Concepts

The key idea of verticality in trade is that parts of production are placed in different countries, and that these countries link sequentially. The approaches and definitions to characterize these linkages and concepts are many and needs to be defined precisely. Production in a foreign country can be commenced through arm-length contracts with subcontractors, often called “outsourcing”, or through “in-house offshoring” where a company makes a “Greenfield investment”<sup>5</sup>, merge with or buy another company. All these activities have in common that the firms production activities become more spatially dispersed, or increasingly fragmented.

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<sup>4</sup> Tempest (1996), “Barbie and the World Economy”, Los Angeles Times, September 22, quoted in Grossman and Rossi- Hansberg (2006) pg.1

<sup>5</sup> Greenfield investments occur when firms invest in new physical plant and productive assets.

The concept “*offshoring*” includes both outsourcing and in-house offshoring, and can be defined as “a shift from domestic to foreign suppliers of intermediate inputs and services”, (Ekholm and Hakkala, 2005, page 3). *Outsourcing*<sup>6</sup> is a transfer of one or more functions that previously were performed in-house to an outside foreign provider with the use of an arm-length contract. *In-house offshoring* is a geographical relocation of the firm’s own activities. Thus, the difference between outsourcing and in-house offshoring relates to how the boundaries of the firm is set and not to the verticality of trade per se, making it possible to analyse these phenomenon using much of the same theoretical framework. I will use the term outsourcing and in-house offshoring when the boundaries of the firms are important.

Jones and Kierzkowski (2000) do not focus on the boundaries of the firm when they use the term *fragmentation* in their treatment of verticality in trade. “Fragmentation refers to a splitting up of a previously integrated process into two or more components, or fragments.” (pg. 3) These fragments or production blocks, independent on how the business is organized, can be relocated across borders.

Naturally, I will use the concepts of the authors choice when their theories are described.

### 1.2.2 The determinants of offshoring

Barba Navaretti and Venables (2004) points out that: “Firms’ activities can be concentrated in a single country or dispersed between several, and each pattern has costs and benefits” (pg. 24). The costs of geographical dispersion depend on how the activities of the firm are split, and the characteristics of the firms or the industry as well as characteristics of the home and host country.

A firm may duplicate all its activities in another country, that is, split its production into two identical parts, or it can split the production geographically by duplicating subsets of production. This is called horizontal investments. The focus in this thesis will

mainly be on vertical investments, that is, splitting the activities by function, so that one (or more) particular component(s) are produced in a separate foreign plant. The firm can own this plant, or an external supplier may run it.

There are different costs and benefits associated with splitting activities by function, and these costs reflect the determinants of offshoring, as firms face a trade-off in their decision to offshore production and chooses the alternative that will maximize profits or reduce costs.

The costs and benefits to the firm by horizontal or vertical investments are summarized in table 1.3 and are by large supported by empirical work. The cost by vertically disintegrating stages is disintegration costs such as technical efficiency loss due to loss of economies of integration. Examples of these costs are already mentioned; transportation costs, import tariffs, time costs, co-ordination costs, in addition to transaction costs. The benefits of geographical dispersion are threefold; “market access”, “competition” and “factor costs”. (Barba Navaretti and Venables, 2004)

TABLE 1.1 BENEFITS AND COSTS TO THE FIRM OF HORIZONTAL AND VERTICAL FDI<sup>7</sup>

	Horizontal	Vertical
Costs	Returns to scale foregone Disintegration costs	Disintegration costs
Benefits	Market access: *Saving trade costs *Strategic advantage	Factor cost saving

Source: Barba Navaretti and Venables (2004)

If a company can duplicate downstream stages of its production into markets with demand for their product, a company can save costs by avoiding transportation costs and tariffs. In addition, proximity to the final market enables firms to shape their

<sup>6</sup> Originally outsourcing is an abbreviation for “outside resource using”. Outside means to create value outside the companies boarder, using external resources.

<sup>7</sup> Barba Navaretti and Venables (2004), studies the gains and benefits by splitting production, which is common to both producing in-house (FDI) and to outsourcing.

products to the local tastes and react quicker to changes in demand. Presence in the local market can also be important in terms of interaction with competitors because an investment that reduce trade costs, possible in combination with lower production costs, will affect the marginal price and the volume sold in the market. Depending on the competitive environment<sup>8</sup>, a lower marginal cost may reduce the sales volume and prices of the other firms, or even lead to exit of some competitors. (Barba Navaretti and Venables, 2004)

Differences in factor costs of primary inputs in production are probably the main motivation for vertical investments<sup>9</sup>. Moving for example unskilled labour intensive activities to countries where wages for unskilled workers are low or research and development (R&D) activities to countries where the cost of scientists is low, enables cost savings. Examples of this are the expansion of European Union's investments in Central- and Eastern European countries and the US investments in Mexico and Bangalore.

These costs and gains, reflecting the determinants for offshoring, will function as building blocks for this thesis. I will discuss the gains and costs using theory and descriptive analysis.

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<sup>8</sup> This could be the mode of competition, such as Bertrand (price competition) or Cournot competition (competition in quantity) and market concentration.

<sup>9</sup> Barba Navaretti and Venables (2004)

## 2.0 THEORY

### 2.1 INTRODUCTION

Offshoring can be explained by different disciplines and models within economics. As Markusen (2005) points out “we can usefully draw from a number of existing theories and models of trade in order to make progress on offshoring”. He points out six directions of theories that might be useful in explaining offshoring:

- A. Comparative advantage theories of trade in goods.
  - a. Ricardian model of trade
  - b. Heckscher-Ohlin theory
- B. Non-comparative-advantage theories of trade, with focus on scale economies, imperfect competition, and product differentiation. Also this branch includes firm specific assets and heterogeneous firm models.
- C. Trade in factors
- D. Theories of Forward Direct Investments (FDI) and arm's length trade in firm specific assets.
- E. Trade in business services.
- F. Liberalization: trade expansion at the extensive margin.

In this thesis I will mainly focus on theories pointed out under A. B. and D. The comparative advantage theories pointed out under A. are valuable in explaining the potential cost savings by placing production abroad. This is because these theories explain how differences in factor endowments and technology will affect the price of production; a lower production cost may attract foreign companies in their search for lower costs, enabling them to compete globally or to increase or sustain their market share. Theories from B., will be valuable in explaining how co-ordination costs and frictions in the market may affect the decision to offshore production. Theories from D. will give us some insight in how transaction costs may affect the choice of organizational form when a firm disintegrate stages of production.



The structure of chapter 2.0 will be as follows. In section 2.2 I will take a closer look at the geographical *factor cost differences* as determinants for offshoring, using models within standard trade theory. The models are based on the principle of comparative advantage and describe how differences in technology and factor endowments can affect the decision to offshore production. In section 2.3 I will take a closer look at models that gives weight to *costs arising from disintegrating stages of production*, such as geographical co-ordination costs and transaction costs. Section 2.4 is devoted to *the organizational costs* trade-off arising from fragmenting production and how these costs may affect the decision to outsource or internalize.

## 2.2 FACTOR COST DIFFERENCES

The theory of comparative advantage is usually attributed to David Ricardo after he systematically explained the theory in his book “The Principles of Political Economy and Taxation”. Comparative advantage explains why it can be beneficial for two parties to trade despite the fact that one can produce every good cheaper than the other. This is due to the alternative cost. A country has a comparative advantage when it can produce something to a lower alternative cost than another country. Thus if both countries specialize in production that minimizes alternative cost, it frees up more resources that can be used in production of the good that we are relatively more efficient in producing. Thus, we have a more efficient use of resources and it will be produced more of at least one of the goods. (Norman, 1993)

### 2.2.1 Ricardian Model of Trade

Deardorff (2001) uses the Ricardian model of trade by emphasizing the technological differences between countries<sup>10</sup>. This difference is driving countries to specialize in the good that they are relatively more efficient in producing.

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<sup>10</sup> Assumptions underlying the Ricardian Model of trade is homogeneous goods across firms and countries, cost of labour is homogenous within one country but heterogeneous between two countries, goods can be transported costless between countries, labour can be reallocated costless between industries within a country but cannot move between countries, labour is always fully employed, productivity differ between countries, assumed perfect competitive environments in both countries and consumers maximize utility.

A country is endowed with a fixed amount of labour which it can use to produce two goods, X and Y. The unit labour requirements in production of each are fixed. Assuming that the country is small and open, the country face fixed prices on the two goods given on the world market,  $p_x$  and  $p_y$ . At these prices it can sell and buy at unlimited quantities. Following the theory of comparative advantage, a country will produce and export the good that yields the highest wages for the inhabitants, in the following assumed to be X.

Assuming that fragmentation of X becomes possible. Good X may be produced from scratch or by using the imported intermediate good Z. If a country chooses to import good Z, the demand for Z will equal the demand for X, so that there is a one to one relationship between the imported good and the production of the final good. Opening up for trade in intermediate goods, Deardorff ends up with a standard Ricardian model with trade in three goods: X, Y and Z.

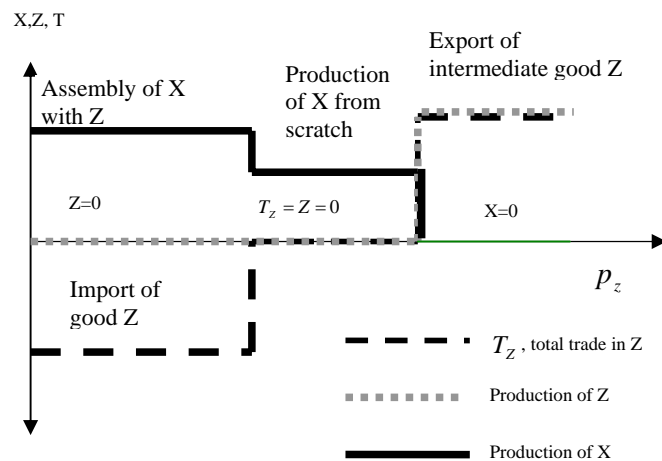
In order to not confuse fragmentation with an improvement in technology, it is assumed that the fragmented technology, that is production of X with use of Z, requires more resources than producing X with the original technology. This is not necessary but illustrates the point that there may be gains from placing production abroad even if the technology is less productive.

Since the intermediate good Z becomes tradable, the introduction of fragmentation also requires that world market provides a price for it, here noted by  $p_z$ . Assuming that the small country trade with “rest-of-world”, an integrated economy, the small country will not be able to affect the prices and there prevails one single wage for labour throughout the rest of the world. Fragmentation that does not lower the labour requirement, since the new technology requires more resources than the original, cannot lower the price of X. The price of X cannot raise either, since the original technology for X still is available. Since this is true, what matters for the small country then, is the price of Z which is dependent on the technology for producing Z in the rest of the world.

What happens in the small open economy when we open for fragmentation?

The labour can choose between producing X from scratch, producing Y or producing X using the imported intermediate good Z, in which it choose the activity that yields the highest wage. This is illustrated in graph 2.1. The y-axis shows the production of X and Z, in addition to the total import/export of the intermediate good Z. The x-axis show the price of the intermediate good Z.

**FIGURE 2.1 FRAGMENTATION**



Source: Modified, Deardorff (2001) "Fragmentation in simple trade models"

If the price on the intermediate good Z is sufficiently low, for example if rest-of-world has a more productive technology in production of the intermediate, home will import the intermediate good Z and produce the final good through assembly. For low prices on Z, measured on the x-axis, we see that production (and export) of X using the intermediate good Z is higher than when the country produces the good from scratch. This is true despite the fact that we need more labour in assembly of good X because the price of the imported good is lower than the cost of producing everything at home.

For a higher price on the intermediate, it will be optimal to keep the old technology; producing X from scratch. If the price on Z on the world market is high, reflecting the comparative advantage to "home" in production of Z, it is better to undertake the production of the intermediate at home, earning higher wages by selling it to another country. We can see the total trade in Z given by the bold discontinuous line.

What can this simple model really tell us? The main insight is that a country (or industry, firm) tends to specialize in whatever activity that gives the highest wages or profits. This specialization depends on the differences in technology between countries. Fragmentation may give a country a comparative advantage in a good that they did not have comparative advantage in before, thus a production technology allowing for fragmentation may give rise to new patterns of trade (following from new patterns of comparative advantages).

### 2.2.2 Heckscher- Ohlin Model of Trade

In a Heckscher-Ohlin framework, trade is explained from differences in factor endowments; differences in skill (human capital), land (natural resources of all sorts), and labour (the number of people in a countries labour force). A country abundant in labour<sup>11</sup> will have a comparative advantage in production of labour intensive goods, following from the fact that the relative prices on the abundant factor will be lower. The greater the difference in factor intensities used in production between the countries in question, the more we can save by placing production abroad. (Norman, 1993)

The application of Heckscher-Ohlin model of trade on offshoring is in many aspects similar to the traditional Heckscher-Ohlin model of trade in final goods. Differences in factor endowment determine the pattern of international trade, where a country will export (intermediate) goods which require relatively more of the factor that a country is abundant in. The difference between the model used in final- and intermediate goods arise since production can be fragmented into different stages or production blocks. These production blocks may be more specialized. A company may choose to split production into three production blocks dependent on the intensity of skilled used in the production process, that is, one block is unskilled labour intensive, another may be skilled labour intensive while the last may be capital intensive. By doing so, a company can offshore production blocks to countries abundant in that

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<sup>11</sup> It is necessary to point out that the educational level between the labour forces may be different. A country abundant in unskilled labour will have a comparative advantage in unskilled labour tasks, while a country abundant in skilled labour will have a comparative

factor that the production block use more intensively, such as offshoring unskilled labour intensive production blocks to Asia. In the standard Heckscher-Ohlin model of trade in final goods, this refinement of production is not possible, and it is the factor intensity of the final good that matters for where a good is produced.

The Heckscher-Ohlin model differs from the Ricardian, outlined above, in that it assumes that the technologies are the same across countries. Also, due to differences in the price of factors between countries, the input composition will be different. It is assumed that labour and capital can be re-employed costless in another sector of production, but that they are immobile between countries. Patterns of demand are also assumed to be similar in the countries. Furthermore, all cost of trade, such as transportation cost and tariffs are assumed away.

Deardorff (1998) uses a variant of the standard Heckscher-Ohlin framework to explain cost savings from fragmentation. Deardorff analyses two countries, “North” and “South”, where North is capital abundant and South is labour abundant. This implies that capital is relatively cheaper in North than in South. He assumes that the fragmentation will be an insignificant part of the economy, so that fragmentation does not change the factor prices in any of the two countries. Furthermore, he only considers goods that are produced in one country, which in the following will be good X.

The scenario of fragmentation is illustrated in the Lerner diagram, figure 2.2, below. The unit value isoquant arises from the production function and the given nominal prices so that  $p_x X = 1$  or  $X = 1/p_x$ <sup>12</sup>. The production function, X, determines the shape of the isoquant giving us different combinations of factors that will make one unit of worth.

The unit isocost lines are marked as ACD and BCE for South and North respectively, showing the combinations of factors in the two countries worth one dollar. As South is labour abundant, the wages here will be lower than in North, implying that North will

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advantage in performing tasks requiring skilled labour. Usually the term labour intensive means that a country is abundant in unskilled labour.

have a steeper isocost curve than South. The optimal solution, that is where a good is produced, will be where the isoquant line touches the unit isocost line.

In the diagram below, it is assumed that good X is produced by South<sup>13</sup>, as the technology demands more labour in production than optimal in North, thus the unit value isoquant touches the isocost line on the line AC.

Deardorff (1998) proposes two models, one model with the assumption that the technologies used under fragmentation always use the same amount of resources as the original seamless technology, the other where the fragmented technology uses more resources than the original technology. I will in the following assume that the fragmentation is costless, so that the fragmentation uses the same amount of resources as the seamless production. This will not always be the case, but it illustrates cost savings as a determinant for offshoring. There will also be possible to save costs under costly fragmentation<sup>14</sup>.

Allowing for fragmentation of good X, there will now exist two different factor combinations, one more capital intensive than the other, which together permit the same amount of good X given by the isoquant. The same amount of good X, produced by the isoquant  $X = 1/p_x$ , can now be produced using one fragment that requires a vector of factors shown as OZ and another fragment that requires the vector ZY. The vectors are constructed so that the factors used in seamless production equals factors used in fragmented production<sup>15</sup>. Since this is the case, a producer in South may as well choose the fragmented production of good X as it will not lose or win from doing so.

If the fragment OZ represents production of a final good, South would never have produced this good, because it would have required more capital than optimal. We

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<sup>12</sup> Here  $p_x$  is the world price on good X.

<sup>13</sup> It could have been the case that the unit isoquant line touched both North and South's isocost line on both sides of C, in which it would be optimal for North to produce some of good X as well.

<sup>14</sup> To see more about costless and costly fragmentation read Deardorff (1998) "Fragmentation across Cones".

<sup>15</sup> Measured on the X and Y axis respectively, and follows from "costless" fragmentation.

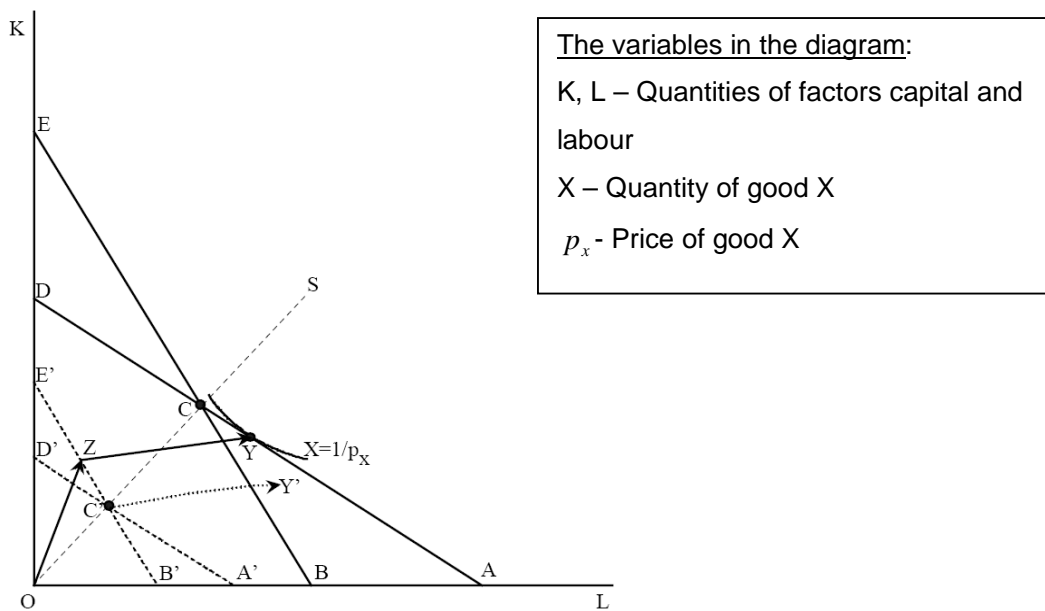
should therefore expect that the fragmented part OZ will be produced in North. Assuming that North will produce the capital intensive fragment and South produces the labour intensive fragment, the cost of producing X will fall and the isocost lines shifts inward to  $A'C'D'$  and  $B'C'E'$  in parallel distance to ACD and BCE respectively, both contradicts inward to the origin by the same amount and such that the arrow of the vector OZ touches the outermost line of  $B'C'E'$ . The contradiction follows from the fact that each country now engage in the production, rather than South engaging in the whole process.

Point C' on the intersection of the two isocost lines, represents the cost of producing the fragment OZ in both North and South, thus point C will be the point where South is indifferent of producing OZ and must therefore be the origin of the vector  $C'Y'$ . The vector  $C'Y'$ , used in production in South, must be in equal length and direction as the original ZY, as the fragmentation is costless.

We see that the tip of vector  $C'Y'$  will be on the inside of the original isocost line, meaning that we are able to save costs, even if we use the same amount of resources as before fragmentation. The reason is that the capital abundant North has lower prices on capital, and is able to produce the capital intensive good cheaper than South.

This variant of the Heckscher-Ohlin model shows that fragmentation of a good leads to cost savings because differences in factor endowments affect the cost of production. Splitting up production into stages allows a higher degree of specialization, which may be relocated to countries with access to cheaper factors used more intensively in production. This allows for cost savings.

FIGURE 2.2 COST SAVINGS FROM COSTLESS FRAGMENTATION



Source: Deardorff (1998) "Fragmentation across Cones"

### 2.2.3 The Product Cycle

Ray Vernon (1966) introduced the theory of "product cycle" where he explains the geographical patterns of where a good is produced. This theory is inspired by differences in technology and factor endowments. The technology of a product will first be produced in a developed country (R&D intensive countries such as USA) where different production techniques are tried out, while the product is still not standardized. When a simple production method is discovered, there will be a shift in the comparative advantage, and countries with relatively less R&D activity start to use the technology. When the product mellows and new generations of the product have been developed, the less developed countries will undertake production that has become relatively unskilled labour intensive. The developed countries engage in new innovating production technologies.

The product cycle theory can be valuable in explaining why more standardized products are offshored to countries abundant in unskilled labour, while production of products that requires more skill contents will be offshored to countries with more advanced technology or educated labour force (or continues to be produced in the home country).



## 2.3 COST TO DISINTEGRATE STAGES OF PRODUCTION

### 2.3.1 Service link costs

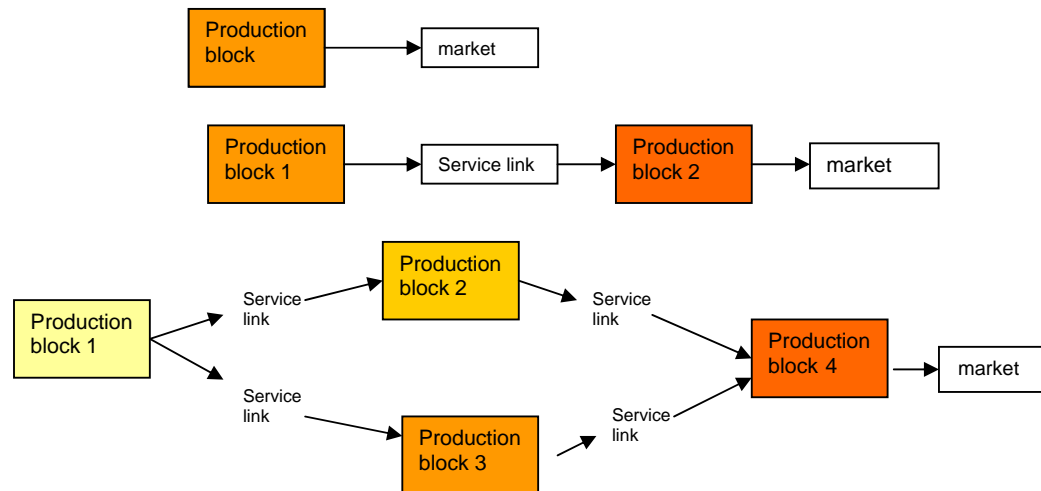
The models of comparative advantage outlined above assume away all costs involved with trade and fragmentation, which is the geographical co-ordination cost. They can not explain how increasing integration of markets, falling trade costs, better co-ordination in transportation and technology affect the decision to offshore. These aspects are the main elements in the model proposed by Jones and Kierzkowski (2000), which focuses on the evolving costs that arise from linking different stages of production.

The cost trade-off can be related to Adam Smith who highlighted the advantages of increasing scale of production when the labour used in production are more specialized. If a company's output expands it can choose to separate the production process into two (or more) production blocks where more specialized production is undertaken. This increased specialization may lead to lower marginal costs but it also leads to higher cost due to coordination between the production blocks.

Jones and Kierzkowski (2000) create an analytical framework where production of a good can be fragmented into production blocks and where these production blocks need to be co-ordinated to a fixed cost. They argue that geographical separation of production blocks introduces the necessity of establishing service link in the form of transportation, communication and other co-ordinating activities. They model these costs as fixed, since "for example, the communication costs of establishing a shipment of one thousand units may be the same as for ten thousand units". (Jones and Kierzkowski, 2003, pg. 5)

As production processes allow us to spatially separate production nationally or internationally, a finer and more specialized division of labour can be used in each stage of production. A finer degree of specialization leads to higher fixed costs but also lower marginal costs by exploiting comparative advantage

The degree of fragmentation can be simple or complex, as figure 2.3 shows.

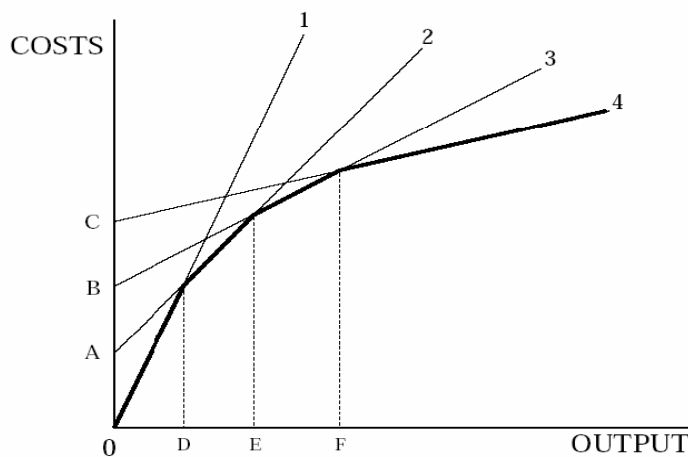
**FIGURE 2.3 PRODUCTION BLOCKS**

Graph 2 copied from S. Arndt and H. Kierzkowski (2001) "Fragmentation", Oxford University Press

The upper panel depicts a traditional situation where all production is organised in one production block. The middle and the lower panel depict situations where production is fragmented (the lower panel is more complex than the middle panel), then assembled before sold in the market.

Graph 2.3 illustrates the costs associated with fragmentation. The x-axis measures the output while the y-axis measures the costs that arise in fragmentation of production. The fixed costs are represented by A, B and C, while the marginal cost of production can be seen as the slope of the straight line

FIGURE 2.4 Co-ORDINATION COSTS



Jones and Kierzkowski (2000), "A framework for Fragmentation"

Ray 1 reveals the costs if all the production is undertaken at home under constant returns to scale. If production is fragmented into two parts, the firm will have to pay a fixed cost equal to  $OA$  in the diagram above. But such a fragmentation will give a lower marginal cost, shown by the slope of  $A2$ . Lines 3 and 4 show how a higher degree of fragmentation will lead to higher fixed cost but lower marginal cost, and the corresponding optimal output to choose further fragmentation (i.e.  $D$ ,  $E$ ,  $F$ ). The bold inner locus shows us the cost minimizing behaviour. The first fragmentation will only be cost efficient if the output increase above  $OD$  and further fragmentation thus depends on output. As we can see, the graph exhibits increasing returns to scale.

Jones' and Kierzkowski's model does not contradict the comparative advantage models explained in the last section because these models explain the re-alignment of production patterns among countries due to different technology and factor endowments. Rather, Jones and Kierzkowski argue that the rise of production networks additionally can be explained by another approach: *it is a firm's fixed and marginal costs that arise from fragmentation that determine where and how much it is optimal to offshore.*

### 2.3.2 Transaction costs

In this section I will take a look at costs that may arise when a company place production abroad, more specifically- *transaction costs*. Transaction costs must be added to other costs that arise in the planning offshoring, and may be seen as a part of the fixed costs in the model proposed by Jones and Kierzkowski.

*Transaction costs*<sup>16</sup> are costs that occur in making an economic exchange because of uncertainty and imperfect information. The theories of transaction costs translate these market failures into additional costs to a firm as they transacts on the market. A firm that decide to *outsource* parts of production uses the market to allocate resources to given prices. Transaction cost is thus dependent on how the firms choose to organize its activities, and will therefore determine where the boundary of the firm is set (i.e. whether it choose to use an external supplier or to use in-house offshoring). (Hart, 1995)

Williamson (1985) argues that there are three main sources of transaction costs: *Search and information costs, bargaining costs and enforcement costs*. Transaction costs will be affected by five critical dimensions: *frequency, uncertainty, asset specificity, bounded rationality and opportunistic behaviour*. Dahlman (1979) argues that all transaction costs are in fact *information costs* since there are insufficient data about the opportunities for trade, lack of information about preferences of economic agents which lead to bargaining costs, and incomplete contracts that will rise the enforcement and monitoring cost.

When a firm chooses to *outsource* production, it needs to settle a contract specifying terms of trade. A contract between two parties will be incomplete when something is left out or when something is ambiguous<sup>17</sup>. This will normally be the case since the costs associated with writing a complete and legally enforceable contract are high, and the limited ability to foresee all possible contingencies. This will often lead to costly re-negotiations and bargaining of contracts in addition to increased enforcement costs. Additionally, even if individuals and firms intend to act rationally,

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<sup>16</sup> Ronald Coase (1937) used the term “the cost of using the price mechanism”.

limitations on our ability to process information and communicate may be circumscribing this intention. *Bounded rationality* is based on this, assuming that decision makers have limits on their rationality and cognitive capabilities. These constraints are particularly problematic when the environment ex ante and ex post is *uncertain*. The uncertainty could be related to demand or costs that might change during the period of contract or to uncertainty related to performance by the supplier evaluated ex post. Thus, increased uncertainty around future market, demand, costs, etc. will lead to a higher *frequency* of re-negotiations because limited rationality makes it difficult to foresee all possible outcomes.

There are also costs related to finding information and the right partner to form a relationship with, such as finding a trustworthy supplier with a lower unit cost, good quality, timing and delivery. One central size that influences the costs of finding a suitable partner, as pointed out by McLaren (2003) is the *thickness of the market*. A rise in market thickness can be defined as any increase in the effective number of firms in a given market. That is, the probability of an agent to find a suitable partner, to a given length of time, with whom it will be possible to realize gains from trade. Examples of increasing market thickness are inclusion of new economies such as China, India and Eastern Europe, increased versatility of producers by investing in flexible production equipment and improvements in search technology such as the internet. If the market gets thicker, the probability of finding a partner increases and the hold-up problem, described in the next section, may be less severe as the likelihood of re-selling components increases. On the other hand it may also be more difficult to keep a stable long term relationship, using an external supplier, if it is easy to find a new partner. (MacLaren, 2003)

Nooteboom (1992) looks at the relationship between the size of the firm and transaction costs, and finds that smaller firms often<sup>18</sup> suffer from higher transaction cost. One important reason is that threshold costs, as also noted by Jones and Kierzkowski, arise regardless of size of the transaction, thus weight more heavily for smaller firms with smaller transaction necessities, see figure 2.4. It will only be

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<sup>17</sup> See Oliver Hart (1995)

<sup>18</sup> There may be exceptions, but as noted by Nooteboom, the effect is systematic and pervasive. See Nooteboom (1992), "Firm Size Effects on Transaction Costs" for more details.

profitable to undertake the fixed costs associated with offshoring if the volume of production increases above a certain threshold.

Transaction costs are also assumed to increase with bounded rationality and opportunism. A larger firm, compared to a smaller firm, often has production of scope and/or scale, and tends to serve several markets. Thus they often have to face a wider set of relevant contingencies and have to apply a diverse set of available options for action. This diversification may also spread the risk as long as there is no positive correlation between the outcomes of activities, or markets are uncorrelated. Bigger firms, again compared to smaller firms, often have a more specialized headquarter staff, trained to identify, gather and take in relevant information. Smaller firms are also assumed to be more vulnerable to opportunistic behaviour since suppliers may be in for hit-and-run, not afraid of being punished as they would have been working with a larger firm. Furthermore, smaller firms more easily go broke which may increase the hold-up problem since discontinuity is more likely.

### 2.3.3 Some Implications

The decision to outsource production is dependent on the transaction costs; extra costs incurred by finding a suitable partner, enforcing contracts in poor legal systems, uncertainty, etc. Poor legal systems and corruption may increase the bargaining and enforcement costs, and the likelihood of opportunistic behaviour. Additionally, finding a reliable and suitable partner in a foreign market may be difficult and costly due to language and cultural differences, lack of information, reputation and the way of performing businesses. If the market gets thicker, the probability of finding a partner may increase and the hold-up problem may be less severe. But increased market thickness may also lead to contracts of shorter character.

The size of a firm may also affect the transaction cost, where a smaller firm may suffer under higher transaction costs relative to their transaction necessities and also due to bounded rationality and opportunism.

Transaction cost is an additional cost related to offshoring and must be taken into account in the decision to offshore.

## 2.4 THE CHOICE OF ORGANIZATIONAL FORM

When a firm consider moving production to new markets, does the firm prefer to keep its activities within the firm or do they choose to rely on the market relations? A firm faces a cost trade-off between using in-house offshoring (internalization) and relying on market transactions. Barba Navaretti and Venables (2004) explain the trade-off as “internalization brings on a direct cost penalty, but avoids the problems of contractual incompleteness in dealing with outside agents”. (pg 35)

The literature on multinational companies (MNE)<sup>19</sup> has, during the last 20 years, basically developed around Dunning’s OLI framework. Dunning (1993) groups the motives to undertake forward direct investment<sup>20</sup> into three categories, Ownership, Location and Internalization advantages (OLI).

The intuition of the theory is that if MNE’s were similar to firms that only operate in the home market, then they would not find it profitable to enter markets abroad, due to higher costs. Thus, since forward direct investment exists, there must be that some companies possess some advantages that are easier to exploit through investment abroad (Gattai, 2005).

Ownership advantages mean that firms possess some specific assets (product, production process, know-how, etc) which the competitors do not have access to, which is sufficient to outweigh the disadvantages they face by competing with firms located in the foreign market. Location advantages can be related to the Heckscher-Ohlin framework outlined above or due to gains from lowering transportation cost or avoiding tariffs. Given that the O- and L advantages are realized, a company must find it profitable to use these advantages it self, rather than selling the assets or the right to use the assets to other companies. These advantages are called

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<sup>19</sup> “Multinational enterprises are firms that own a significant share (typically 50% or more) of another company (henceforth subsidiary or affiliate) operating in a foreign country.” (Barba Navaretti and Venables, 2004, pg. 2)

<sup>20</sup> “FDI is an investment in a foreign company where the foreign investor owns at least 10% of the ordinary shares, undertaken with the objective of establishing a ‘lasting interest’ in the country, a long-term relationship and significant influence on the management of the firm” (Barba Navaretti and Venables, 2004, pg. 2)

internalization advantages. That is, the I-advantage arises if allowing another company to use the asset would increase the probability that the value of the asset to a MNE would diminish under the other company's control. It is assumed that the more the ownership- specific advantage possessed by an enterprise, the greater is the incentive to internalize them. (Dunning, 1993).

Following Dunning (1993), the make-or-buy decision of a multinational enterprise is usually explained in terms of costs and benefits of using the market. The penalty of internalization is that the firm embark on doing the activity it self, not finding the cheapest local supplier. The local supplier may have advantages in terms of knowledge of the local conditions, such as labour skills, local demand or administrative procedures, enabling the local supplier to have lower production costs. The local firm may also have specialized competencies in this specific kind of production and/or it may have plant-level economies of scale. The costs by choosing an external supplier (i.e. using the market), as already explained, is due to the transaction costs, imperfect information and contractual incompleteness. Furthermore relying on the market may be highly risky due to technology transfers, moral hazard and defection by the local firm, agent opportunism and reputation concerns<sup>21</sup>. (Barba Navaretti and Venables, 2004)

Emerging from the friction in the market is “the hold up problem” which relates to the choice of organizational form. Two parties that wish to enter a production relationship, using the market allocations, will in many cases need to undertake investments to be able to produce and assemble goods (e.g. in machinery or re-adjustment in existing machinery, training of employees, etc.). That is, the relationship needs investments in *specific assets* to gain the most of the relationship. Relation-specific investments are typical when an input supplier has to invest in equipment whose characteristics are specific to a particular buyer, but of little use to other buyers in the market. Such investments determine the degree of specialization

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<sup>21</sup> See for example Gatai (2005). These issues will not be treated here but are all relevant for the decision of organizational form. For an introduction to agency costs see Barba Navaretti and Venables (2004) or for an extensive analysis see Laffont and Martimort (2002). Dissipation of intangible assets, is also relevant, but is more likely to occur if the firm choose to duplicate its activities, and is out of the scope of this thesis. For more information see Barba Navaretti and Venables (2004) pg 37-39.



of the co-operation and may increase the surplus for both firms as they improve quality and/or increase efficiency. But in a world of incomplete contracts, both companies know that the initial contract will be re-negotiated due to changes not specified in the initial contract, such as changed prices on raw material, required changes in quantity or quality, etc. Thus, the price, quantity or quality negotiated in the initial contract may be subject to change. It is the residual control rights over the assets that cause the problem. If the two firms are not integrated, the single firms do not have any right to decide any modifications in the production process of the other firm. Thus, if the initial contract is renegotiated and the supplier does not deliver the quantity intended in initial contract, the buyer cannot interfere with the supplier assets due to lack of residual control rights.

If the surplus of selling the final good goes to the downstream firm, and the upstream firm only receives a per-unit price (i.e. arm-length contract) negotiated in the initial contract, the upstream firm may find it risky to tailor their equipment to the needs of the downstream supplier. The fear of undertaking a relation specific investment arises because the upstream firm worries that the price in the new contract will not cover their investment cost. If the tailored product cannot be re-sold on the market, the upstream firm loses bargaining power in the re-contractual stage as the downstream firm knows that the upstream firm rather will sell the goods to a lower price than not selling them at all. This dilemma is called the *hold-up problem* because each party is anxious that the other party will “hold it up” at the re-negotiation stage. The parties would rather make investments that are non-specific because these will increase a firm’s possibility to re-sell its input if the price given by the downstream firm is too low after re-contracting (and its bargaining power will thus be higher)<sup>22</sup>. Such behaviour is related to *opportunistic behaviour*, in that decision makers unscrupulously seek to serve their own interest by taking advantage of their superior knowledge, failing to disclose important information to the other party which may affect the price of the widget. Thus, it is difficult to a priori evaluate whether the other party is trustworthy or not. (Hart, 1995)

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<sup>22</sup> Or a downstream firm will not adjust its assembly machinery to accept a specific input. The firm will rather make investments that fit standardized intermediate goods because it is frightened that the downstream firm will demand a higher price on the intermediate good when it knows that the upstream firm is dependent on their good.

Thus, one problem of using external (market) transactions is the hold-up problem associated with incomplete contracts. This problem leads to under-investment of specific assets. The benefit of integration is that the firms' incentive to make relation-specific investments increase, and "integration is assumed to be the only way to deal with uncertain contingencies affecting the technical relations between the MNE and upstream producers that cannot be dealt with using arm-length contracts" (Barba Navaretti and Venables, 2004, pg 103). This will happen since the acquiring firm gets a higher fraction of the ex post surplus created by these specific investments. But integration has its costs as the downstream firm loses the comparative advantage of using a local supplier, thus may imply a higher average cost of production. Furthermore, internalizing activities may also reduce the flexibility of changing suppliers when the demand, cost or technology alters. (Barba Navaretti and Venables, 2004)

We may expect that the hold-up problem is more rigorous in some industries. Especially if the relationship requires specialized inputs which are difficult to re-sell on the market or if the competitive environment or costs are uncertain, making renegotiations likely. High asset specificity may increase the likelihood of the firms integrating.

Empirical literature confirms that outsourcing is more efficient when the asymmetries between them are not too large. As noted in Hart (1995), there has been a trend that larger factories have been replaced by factories with smaller scale and more flexible technologies. More flexible factories allow for less complementary assets since it more easily can be modified to be suitable for a new trading partner, and reduce the hold-up problem.

## 2.5 CONCLUSION

The decision to split the production process by function, geographically and organizationally, has its costs and benefits. The theories of comparative advantage explain how differences in factor endowments and technology give rise to gains from fragmenting production. Access to cheaper labour will according to these theories imply that production of more labour intensive, or standardized, components should be placed in countries abundant in unskilled labour. The production cycle theory suggests that the geographical patterns of where a product is produced will be determined by differences in technology, but is also related to differences in factor endowments.

The costs associated with splitting the production is related to geographical costs of co-ordination, such as trade costs, co-ordination costs as well as transaction costs. Furthermore a firm face a trade-off in the choice of organizationally splitting production related to transaction costs and imperfect information.

### 3.0

## DATA AND SOURCES OF ERROR

The availability of public data and research on the determinants of offshoring of Norwegian industry is relatively limited<sup>23</sup>. The same is true for research on firm- and industry level differences related to offshoring. The limited amount of public data places restrictions on the possible exploration of data and extent of empirical analysis.

Chapter 3.0 will explain the sources of data used (section 3.2) and the possible causes of errors (Section 3.3).

### 3.1 SOURCES OF DATA

The main source of data used in this thesis is from a cross-sectional survey conducted in 2001 by an organization representing the technology industry (Teknologibedriftenes Landsforening, TBL) in Norway. The survey classifies the technology industry into ten categories; Metal goods, textile, machinery, furniture, ship equipment, ship building, electronics, information technology, foundry and offshore. Since I have not had access to TBL's segmented data<sup>24</sup>, I have followed the PRODCOM coding<sup>25</sup> which was accessible with the financial figures from the Dun and Bradstreet database (see next paragraph). The PRODCOM coding is a common classification system developed by the European Union for segregation of industrial sectors. Using this classification system, I end up with twelve sectors: Textile and textile products, furniture, metal and metal goods, machinery, electronics, offshore, transportation, computer/IT, plastic and rubber products, telecommunication, glass and ceramics and production of chemicals. There are less than nine responses from five categories, and combined they represent only 6% of the total sample. Due to the

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<sup>23</sup> I know that NHO works to establish a panel data to see trends and developments in offshoring, but these data were not public as of October 2006.

<sup>24</sup> The ship equipment industry may include firms from several sectors, such as electronics, computers, textile, machinery and metal.

<sup>25</sup> Can be downloaded on the SSB's webpage: <http://www.ssb.no/emner/10/07/prodcom/>

relatively few respondents from these categories, I combined them into one single category named “Other”.

TBL asked all its 1,200<sup>26</sup> members about their degree and type of offshoring, experiences and future plans<sup>27</sup>. Examples of questions were in which countries they have production and whether the relationship was through an arm-length contract, production co-operation or own establishment. The respondents were also asked to give information regarding turnover and share of turnover created abroad and experiences they have had with quality, price and delivery. There were a total of 449 firms that completed the survey successfully.

The data from the survey is linked to accounting variables from Dun and Bradstreet’s (D&B) database matching organisational numbers searched for in “Register authority and source of information”<sup>28</sup>. The dataset from D&B is complementary, giving us access to nearly 150 financial and descriptive variables for each year between 1992 and 2004. The survey was conducted in 2001. Assuming the respondents were referring to past experiences (2000) and not their current plans (2001), I have chosen to pair the TBL data with financial numbers from 2000.

### 3.2 RESPONSE RATE, NON-RESPONSE ERROR AND OTHER SOURCES OF ERROR

The goal of the survey was to investigate the extent of offshoring among the members of TBL. In doing so, they asked *all* of their members to complete a questionnaire. 449 of 1,200 firms successfully answered the survey, which account for a response rate equal to 37.4%. It is generally difficult to say that a specific response rate is good or bad. It is more important to ensure that the sample answering the questionnaire is representative and reducing bias<sup>29</sup> by carefully evaluating the design.

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<sup>26</sup> TBL had approximately 1200 members 1<sup>st</sup> of January 2001. Source: Knut R. Skotner, Norsk Industri, Leader Industry and Politics division.

<sup>27</sup> The questionnaire is added in the appendix.

<sup>28</sup> Brønnøysund registeret

<sup>29</sup> A sampling bias is the measure of the location of the sampling distribution relative to the true value.

I assume the respondents in TBL's survey is representative, since they asked all their members, hence no *sampling error* in our sample. However, there may be possible *non-response errors*<sup>30</sup> and *measurement errors*<sup>31</sup> which occur due to flaws in the design of the survey.

Non-response errors occur if the respondents do not provide answers for different reasons such as refusal, lack of time, loss of questionnaire, inability to provide answers, etc. If the difference between the statistics for responding units and sample units is high, the effect of non-response on the survey estimate can be quite significant. No matter how carefully a sample is selected, some members of the sample do not respond to the survey questions. When the firms, that answer the questionnaire, differ from the firms that do not answer the questionnaire, non-response error will be an issue. Following Groves (1989, pg 133) we can define the non-response error as follows:

$$y_r = y_n + \frac{nr}{n}(y_r - y_{nr})$$

Where

$y_r$  = the statistics for all responding units

$y_n$  = the statistics for all n sampling units

$y_{nr}$  = the statistics for all the non-responding units

$\frac{nr}{n}$  = the non-response rate

The latter term  $\frac{nr}{n}(y_r - y_{nr})$  is the estimate of the non-response error in one

application of the survey. We see that the non-response rate increases the error, but it is dependent on the difference in the statistics between the true and estimated values. Thus, if the responding units differ from the non-responding units in our

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<sup>30</sup> The failure, for any reason, to obtain information from a designated individual (unit).

<sup>31</sup> Unlike non-response error, the measurement errors arise due to mistakes made by the respondents. Measurement errors occur when respondents fill out surveys, but do not respond to some questions, or they provide inadequate answers.

sample and the response rate is low, this may indicate that the statistics from our sample will differ significantly from the true value of our population.

Firms that answer the questionnaire may provide erroneous information, increasing the measurement errors, due to recall errors, inaccurate answers or of other reasons<sup>32</sup>. The design of the survey is important in minimizing the probability for these errors.

Potential sources of bias using the numbers collected from TBL are, in my opinion, particularly connected to which firms that are inclined to answer the survey and potentially increase the non-response error explained above. To answer the questionnaire the survey must reach the person in the company with the relevant knowledge and authority. In a bigger company, a number of people may have to contribute to answer all the questions, increasing the likelihood that some people do not have the time or the correct information to answer the survey, or that the right person is not reached. Finding the relevant information in a smaller company may be easier since the company is more surveyable. Another potential error is that companies with offshoring might be more inclined to answer the questionnaire as they deem the questions to be more relevant for them than companies without offshoring. As noted by Heberlein and Baumgartner (1978), questionnaires are more likely to be returned if the respondents consider them relevant.

There might also be potential sources of measurement errors due to the design of the questionnaire. In the questionnaire from TBL, question 3 and 9 ask companies to respond turnover moved to foreign production. However, most companies use turnover as a measurement for sales rather than production and might have been confused by the question. Furthermore, it may be easier to mark the completed alternatives in question 6 than to fill in "other reasons", possible leading to a lower response rate of other important reasons for offshoring.

Other sources of errors may follow from loss of data. Since the data from the survey was collected in 2001, there have been changes in ownership, mergers and

acquisitions, companies might have been liquidated or changed names. Thus, by combining the datasets some companies have been excluded from the sample, as matching organization numbers could not be found in all cases. Some companies were also excluded due to errors in their financial and descriptive numbers from the D&B database, such as reporting a negative number of employees. Not all companies had a complete set of financial figures and descriptive set of data from the D&B database. The loss of data may be a source of error, since the apostasy may be unevenly distributed.

The offshoring percentage remains relatively stable combining the survey data from TBL with the Dun and Bradstreet's database, as can be seen from table 4.1. While this is true, it is important that we interpret the numbers with care.

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<sup>32</sup> There could be that firms wish to overstate/understate information to make impact on politicians/ researchers



## 4.0

### DESCRIPTIVE ANALYSIS AND DISCUSSION

#### 4.1 INTRODUCTION

We can gain insight to the determinants of offshoring by studying the gains and costs of relocating stages of production, and in section 2.0 I reviewed some relevant theories that may explain the trade-off a firm is facing in the decision to offshore production. Differences in factor costs enable firms to save costs from placing stages of production across borders, but fragmentation has its costs due to increased coordination, transaction costs and information costs. In addition, organizational form is chosen based on the cost trade-trade off between in-house offshoring and arm-length contracts.

In this chapter I will analyse whether these cost considerations are important for the Norwegian industry.

In the next section I will take a look at some characteristics of the sample in the TBL survey, such as the distribution of companies within industrial sectors, the extent of offshoring and geographical destinations of offshoring. In section 4.3 I will examine the potential gains from disintegrating stages of production, more specifically the gains from differences in factor costs and potential gains from access to markets. Section 4.4 will describe the costs of disintegrating stages of production, where I will treat transaction costs. Section 4.5 will describe the choice of organizational form. The chapter will end with a brief summary.

#### 4.2 SAMPLE CHARACTERISTICS

The respondents of the survey represent companies with a turnover equivalent to approximately 6 billion Norwegian kroner and 42,500 employees. The technology industry represents around 40% of the value added and 40% of the employees in Norway, and is Norway's biggest industrial branch. The markets are characterized by

fierce competition, forcing companies to specialize using their competitive advantages. This specialization has given some companies relatively high market shares in some niches. Norway, being a small country with unilateral resource foundations, is highly dependent on international trade, in terms of access to necessary goods and foreign capital to take advantage of the natural resources<sup>33</sup>, but also because 4.5 million inhabitants is a small home market for Norwegian companies. This makes it difficult to mark-up international prices when the domestic cost level increases, and have forced companies to constantly progress in productivity. (TBL, 2001)

Table 4.1 shows the distribution of the firms in our sample over industrial sectors. I have included the full and reduced sample<sup>34</sup>. As already noted the percentages remain relatively stable even if firms are lost from our sample in combining the dataset from TBL and D&B.

We see that the industrial sector metal and metal goods represents 25% of our full sample, followed by machinery, textile and electronics with 16%, 13% and 12% respectively. The industrial categories “other” and transportation are the smallest in our sample, each constituting 6% of the full sample.

Looking at the extent of offshoring, 39% of the firms in our full sample, and 41% of the reduced sample reports offshoring. These percentages are high and as explained in section 3.3, it may be that firms with offshoring relates more to the topic and are more inclined to respond than companies that do not relate to offshoring. While this is true, it is no reason to believe that the extent of offshoring is low, or that it has reduced since year 2000/2001. On the contrary, an interest rate of 4% above that of European Union and a strong Norwegian currency in year 2002 and 2003<sup>35</sup> reduced the competitive power of Norwegian industry against our main trade partners<sup>36</sup>.

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<sup>33</sup> Kvinge (2003)

<sup>34</sup> As I combined the two datasets, some data were lost. This was explained in section 3.1.

<sup>35</sup> It was down to 7.20-7.25 against Euro.

<sup>36</sup> See Økonomiske analyser 1/2006, [www.ssb.no/emner/08/05/10/oa/200601/prod-marked.pdf](http://www.ssb.no/emner/08/05/10/oa/200601/prod-marked.pdf)

Furthermore, as China joined WTO in 2001, the competition in the global market has increased. These factors put pressure on saving costs for many firms. In addition, declining transportation costs, more efficient logistics and a diffusion of information and communication technology reduce trade-, communication- and transaction costs makes offshoring easier.

**TABLE 4.1 SAMPLE CHARACTERISTICS**

	Industrial Sectors	Number of firms	Share of firms in each sector (of total firms)	Number of firms with offshoring	Share of firms offshoring (offshoring firms=100%)	Share of offshoring in each sector (total firms each sector=100%)
<b>Full sample</b>	Other	27	6 %	6	4 %	22 %
	Electronics	50	12 %	16	10 %	32 %
	Textile	53	13 %	28	17 %	53 %
	Machinery	66	16 %	32	19 %	48 %
	Metal	107	25 %	29	17 %	27 %
	Offshore	33	8 %	10	6 %	30 %
	Ship	31	7 %	14	8 %	45 %
	Furniture	31	7 %	20	12 %	65 %
	Transportation	27	6 %	13	8 %	48 %
	SUM	425	100 %	168	100 %	-
<b>Reduced sample</b>	Other	23	6 %	5	3 %	22 %
	Electronics	43	12 %	13	9 %	30 %
	Textile	45	13 %	25	17 %	56 %
	Machinery	52	15 %	31	21 %	60 %
	Metal	95	27 %	25	17 %	26 %
	Offshore	22	6 %	6	4 %	27 %
	Ship	27	8 %	13	9 %	48 %
	Furniture	25	7 %	16	11 %	64 %
	Transportation	24	7 %	11	8 %	46 %
	SUM	356	100 %	145	100 %	-

**Notes:** The first column shows the industrial classifications. The second column reports the number of firms in each industry category in our sample. The third column shows the percentage distribution of the firms over industrial sector, where 100% equals all firms. The fourth column shows the distribution of offshoring over industrial sector where 100% equals all offshoring firms. The last column shows the percentage offshoring in each industrial sector, where 100% equals total number of firms in each sector.

Looking at differences between industrial sectors in table 4.1, we see that some industries have higher shares of offshoring than others. The industrial sectors furniture, textile, machinery, transportation and ship building all have offshoring percents above 45% (of the total number of firms in each sector), offshore industry

has 30% offshoring, while “other” and metal have lower shares of offshoring, 22% and 27 % respectively.

The explanation for differences in degree of offshoring can be many. One explanation may be that the composition of factors used in production between the sectors and stages of production may differ. Unfortunately, I have no numbers that take account for differences in factor intensity between the stages of production. Still, differences in average labour intensity between the industries in Norway may give us an indication of which industries that may benefit more from fragmenting production.

Figure 4.1 shows the differences in average labour intensity between industrial sectors in Norway in 2000 and 2004, calculated as labour compensations share of value added<sup>37</sup>. We see that the labour intensity in all sectors has declined from year 2000 to 2004, probably following from increased productivity (and maybe also due to offshoring of labour intensive stages of production). It is important to note that this figure does not separate between unskilled labour intensive and skilled labour intensive.

The graph may support the extent of offshoring over industrial sectors above. Metal and metal goods, with a relatively low share of offshoring, are relatively less labour intensive than the “high offshoring industries” textile, machinery and transportation.

Production of metal and metal goods is relatively energy intensive and Norway being a major producer of hydro electricity creates ideal conditions for these industries<sup>38</sup>.

Another important factor that might explain low levels of offshoring in the metal industry is related to the cost of verticality in trade of metal and metal goods.

Disintegration of stages of production may require that metal must be reheated, thus extra costs of disintegration occurs, making offshoring less likely<sup>39</sup>.

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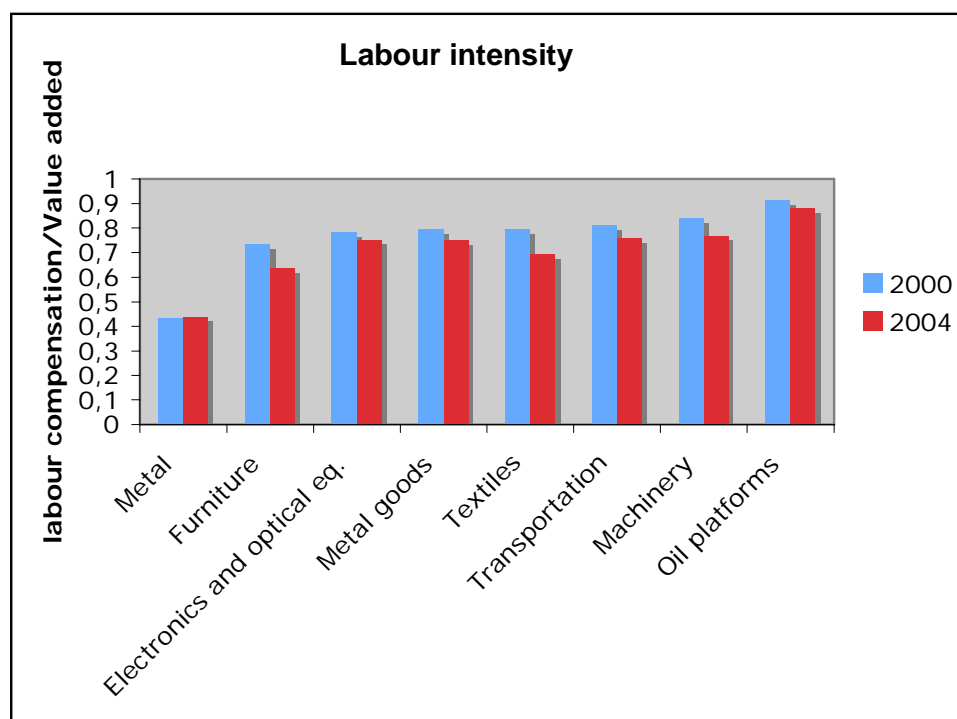
<sup>37</sup> See SSB, 2000, “Manufacturing Statistics”

<sup>38</sup> The process industry in Norway has access to cheaper energy due to contracts formed with the government.

<sup>39</sup> Barba Navaretti and Venables (2004)

The unskilled labour intensive industries, such as production of textiles, may have more to gain from placing production in low cost countries than capital intensive industries requiring labour with specific competencies or specialized machinery not yet accessible in some developing countries.

FIGURE 4.1 LABOUR INTENSITY OVER INDUSTRIAL SECTORS



**Source:** Own calculations based on numbers from Statistics Norway. Labour intensity is measured as average labour compensations share of average value added (in market prices).

Firms and industries may also have *stages* of production, which are more unskilled labour intensive, or where input factors (such as raw materials) are imported from other countries. Examples of such are imported cotton, linen and silk for use in textile production, but also stages of production of offshore and ship (transportation) can be classified as being unskilled labour intensive and may easier be moved to countries abundant in labour. As an example, Aker Yards produces hulls in Romania, while keeping the more skill intensive stages of production in Norway<sup>40</sup>.

<sup>40</sup> Aker Yards moved their production of hulls to Romania in 2001 in order to save costs in the labour intensive stages of production. See NHO "Skape hjemme og ute"

The respondents in the survey were also asked to state destinations for their offshoring. I have categorized the countries into three regions, West (Western hemisphere), Asia and Eastern Europe where each region contains the following countries:

West: Sweden, Denmark, Finland, Germany, UK, Ireland, France, US, Holland, Austria, Belgium, Portugal, Spain, Italy, Scotland and Canada

Asia: China, India, Saudi Arabia, Malaysia, Korea, Thailand, United Arab Emirates, Hong Kong, Pakistan, Taiwan, Vietnam, Sri Lanka, Bahrain and Singapore.

Eastern Europe: Lithuania, Latvia, Romania, Poland, Estonia, Turkey, Hungary, Czech Republic, Russia, Bulgaria, Ukraine, Croatia and Russia.

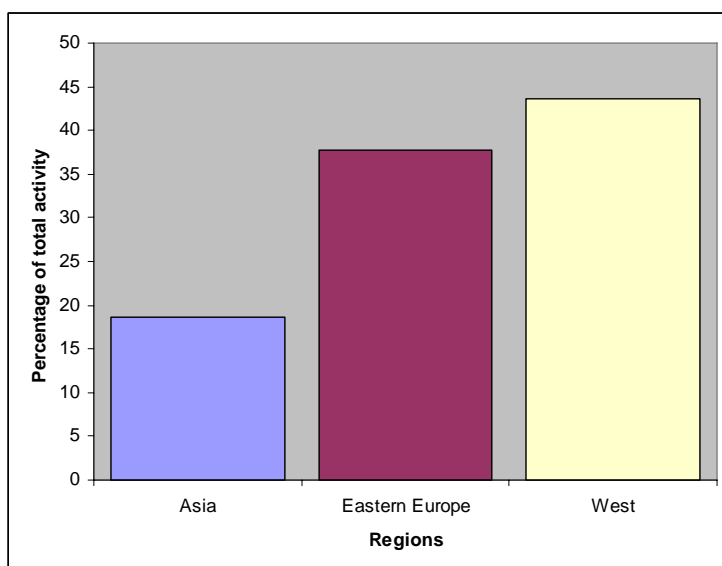
Figure 4.2 shows the geographical distribution of offshoring while table 4.2 gives the top ten destinations to offshore production of the survey's respondents. Figure 4.2 shows that offshoring to low cost countries in Asia and Eastern Europe, in total, is higher than to countries in the Western hemisphere. From table 4.2 we see that Poland, the Scandinavian countries and China is important destinations for offshoring.

Poland and China are countries that are abundant in unskilled labour, which favour offshoring of unskilled labour intensive production blocks. This supports the theory outlined in section 2.2 where gain from offshoring is explained by differences in factor costs since the marginal cost of production is lowered. The costs to disintegrate stages of production, as explained in section 2.3, are cost of transportation, co-ordination and transaction costs. These costs arise from cultural and language barriers, searching for suitable partners, poor legal systems increasing bargaining costs, uncertain contingencies, etc. and are expected to be greater with physical and cultural distance, thus we may expect higher fixed costs associated with offshoring to Asian countries.

Offshoring to the Scandinavian and European countries (including Eastern Europe), on the other hand, is probably reducing the costs associated with disintegration of stages of production. Eastern Europe, Northern Europe and Scandinavia have advantage in proximity to Norway both in physical distance and possibly also with

regards to culture. But the benefit from a lower marginal cost of production is probably less than in the Asian countries. The Scandinavian countries and many countries in the West have a higher educated labour force and may have a more sophisticated technology, thus will attract companies that are searching for specific technology or skills.

**FIGURE 4.2 OFFSHORING ACTIVITIES OVER REGION**



**Notes:** Percentage of total offshoring activity in our sample. Since each firm may be represented in more than one region, the percentage will not be calculated using number of firms with offshoring, but by using the total amount of offshoring activity.

**TABLE 4.2 TOP TEN DESTINATIONS FOR OFFSHORING**

Rank	Country	Number of incidents	Percentage
1	Poland	39	11,50 %
	Sweden	39	11,50 %
3	Denmark	29	8,60 %
4	China	21	6,20 %
5	UK	19	5,60 %
6	Germany	18	5,30 %
7	Estonia	16	4,70 %
8	Lithuania	13	3,80 %
9	Czech Republic	11	3,20 %
10	Italy	10	2,90 %
	Romania	10	2,90 %
		225	66,20 %

**Notes:** Several firms have activity in more than one country. This implies that the number of incidents will be higher than number of firms with offshoring, and that the percentage will be of total incidents.

Figure 4.3 shows the distribution of industrial sectors over regions.

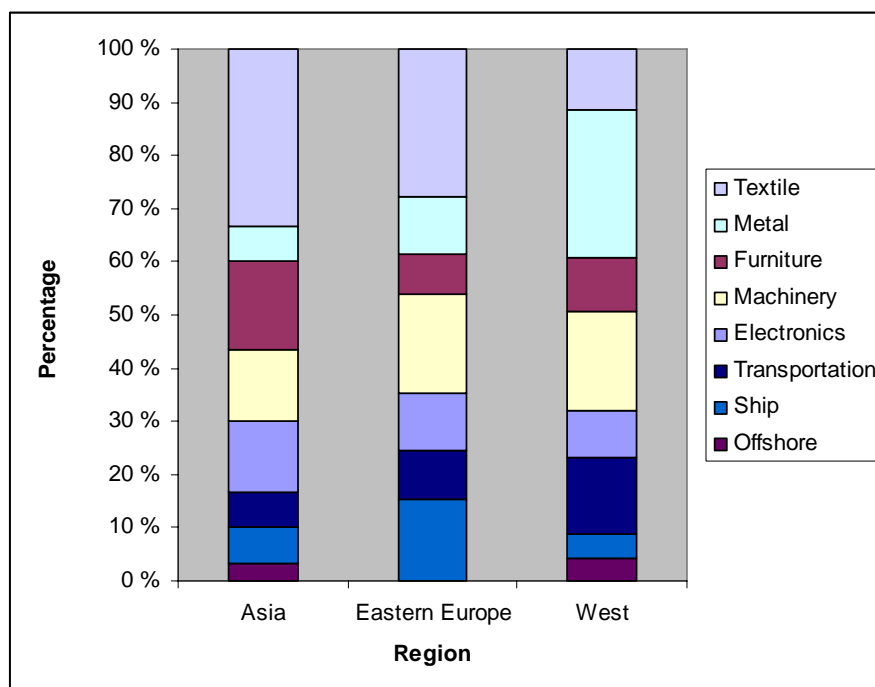
We see that companies within the textile and furniture industries mainly offshore to low-cost countries. While production of textile is more labour intensive than production of furniture, they have in common that they face fierce competition from countries that are abundant in labour, or from other companies that offshore production to these countries. An example of the latter is the Swedish furniture producer IKEA which use external subcontractors in more than 70 countries, generally with a lower price of unskilled labour, close proximity to raw materials and reliable access to distribution channels<sup>41</sup>, enabling them to charge lower prices on their goods. The Norwegian furniture and textile companies may be able to differentiate themselves through specialization and lower the price by producing in low cost countries. And indeed, both the furniture and textile industry have a relatively high share of offshoring to Asia.

Companies within the industries transportation, metal and metal goods, and machinery have high shares of offshoring to western countries. Western countries are relatively well endowed with capital and skilled labour, in addition to a more sophisticated technology. Furthermore, companies within the industries metal and metal goods, transportation and machinery may have a desire to be close to their customers, as they typically deliver semi-finished products. Also, there may be a higher share of research and development activity in some countries, depending on the type of good. For companies that compete in segments with rapid technological changes, it may be beneficial to be located close to these centres in order to quickly adapt to new developments and to get access to specialized machinery and services.

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<sup>41</sup> Barba Navaretti and Venables, 2004



**FIGURE 4.3 INDUSTRIAL SECTORS OVER REGION**

**Notes:** Several firms have offshoring activity in more than one region. Total firms represented in a region equal 100%.

### 4.3 THE GAINS FROM DISINTEGRATING STAGES OF PRODUCTION

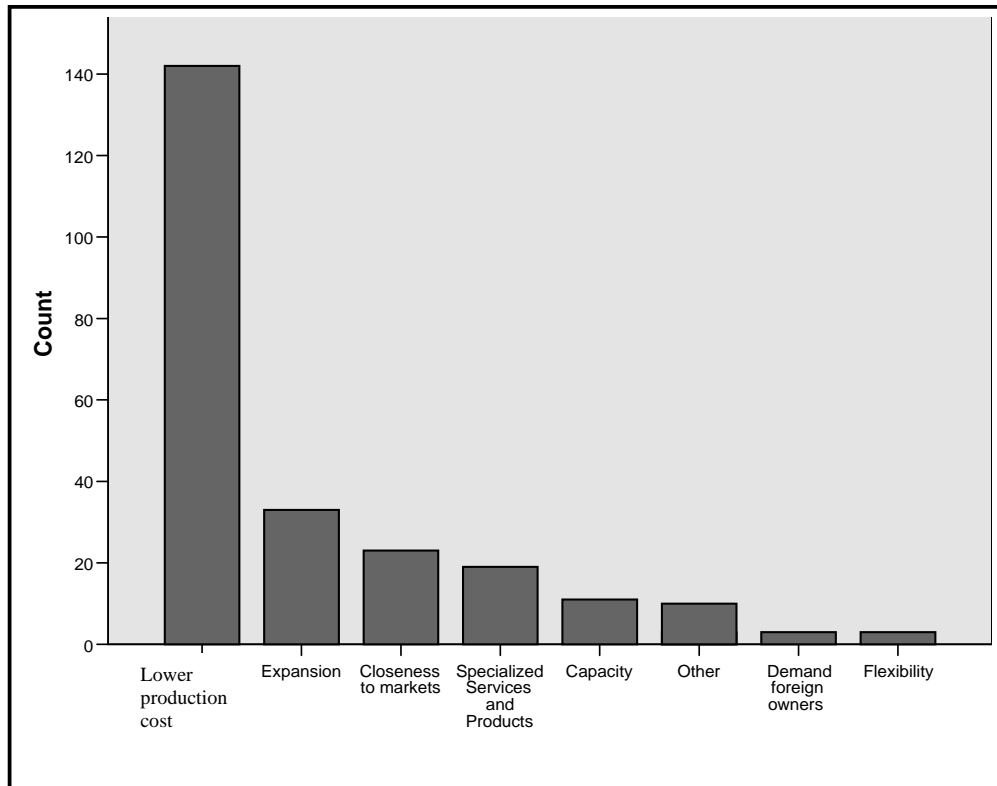
#### 4.3.1 Reasons for offshoring

The respondents in the survey were asked to state the reasons for separating their production geographically. The reasons they state may reflect the underlying objective of offshoring and reveal differences between industrial sectors and firms in their search for gains. The firms could choose among four fixed alternatives following the terminology of the questionnaire; “lower production costs”, “expansion”, “closeness to markets” and “demand from foreign owners”. Additionally, they had the possibility to fill in other reasons they found important. Figure 4.4 shows the distribution of the reasons for offshoring.

Saving costs labelled as “Lower production cost” in the graph and in the questionnaire, is the reason stated more often by all firms, that is, they are searching

for gains from differences in factor cost. This will be treated more extensively in the next section.

**FIGURE 4.4 REASONS FOR OFFSHORING**



We may interpret “*Expansion*” as a search for new markets, or the use of offshoring as a platform to other markets in Europe or Asia. “*Closeness to markets*” can be understood as the desire of being established in a new market through mergers and acquisition or Greenfield investments. The alternative “*expansion*” is the reason that in frequency, while not necessarily in importance, is the second most mentioned reason. Closeness to markets is the third. In section 4.3.2 I will look at access to markets, which is related to these two reasons.

Firms that have chosen to fill in reasons, mainly choose alternatives that are in line with Abraham and Taylor (1996). They propose three reasons for *outsourcing*: “Saving costs”, access to “specialized equipment or skills” and “smoothing workload”. “*Specialized components and services*” is the reason stated most frequently by the

companies that filled in their own reasons for offshoring<sup>42</sup>. “Specialized components and services” may be understood as firms not being able to find the same human capital, resources or technology in Norway. “Capacity” is also given as a reason for offshoring and it may be interpreted as letting external firms produce parts of goods in periods with higher demand rather than expanding the company at home. This may also be related to flexibility as it might be difficult to adjust the work force or capital assets when demand is low.

We see that “demand from foreign owner” is a small group of responses. This disposes the assertion that foreign ownership is equivalent with offshoring. (TBL, 2001)

Looking at the industrial division and the reasons for offshoring given by graph 4.5, we see that saving production cost is the main reason for offshoring in all industrial sectors, but that it has a higher score within ship, offshore, textile and furniture (as a share of the total responses within each category). This is also coherent with the distribution of labour intensity shown in figure 4.1 above. Metal, the least labour intensive industry, are also the industrial sector that have a lower share of responses within “saving production costs” compared with total responses within metal (while not in number). This, as noted, may be due to domestic access to relatively low cost energy.

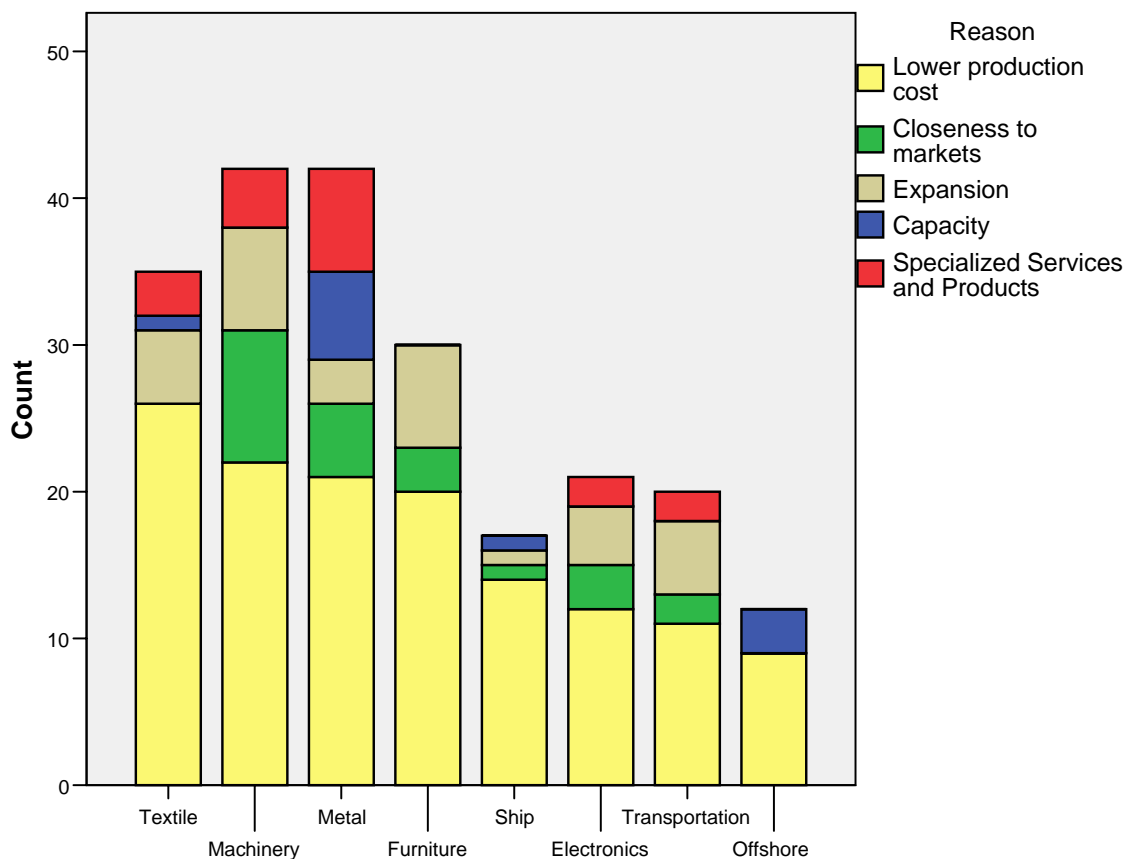
Offshore and Ship building industries have specialized over several years developing specific competencies. From graph 4.5 we see that neither of these two industries looks abroad to find specialized services or products, probably because we have the necessary competencies in Norway. Capacity is mentioned in both industries, which may be explained by occasional large orders which employ all of the production sites, equipment and labour, while in times with lower demand, there may be excess labour and production capacity.

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<sup>42</sup> It may be that it is easier to tick of the completed alternatives, rather than stating reasons them self, thus the categories may be underestimated.

Thus it may increase the companies' flexibility to offshore production when demand for their products and services is strong, increasing the company's fixed cost base to prepare for a potentially weaker market. Tore Langballe in Aker Yards (vice-president, group communication) confirms this: "Moving the labour intensive stages of production to low cost locations make the Norwegian ship building yards more robust in a weak market since we have a more flexible cost structure. We experienced this in 2004 when the Norwegian ship building yards had low activity, but we managed to get through this period in a way that that made it possible to increase activity again". (Translated from Norwegian, NHO, 2005)

**FIGURE 4.5 REASON FOR OFFSHORING OVER INDUSTRIAL SECTORS**



**Notes:** Number of responses in each sector. 425 firms. Excluded: Industrial sector "other" and Reason "other".

### 4.3.2 Factor Cost Savings

*“The more or less sudden opening of trade between devastated, poor ex- communist countries and the highly productive and rich western countries was like opening the weirs between two lakes of different heights”*  
(EEAG report pg. 42)

As explained in section 1.2, the gain from relocating stages of production is differences in factor cost. The reason for this was explained in section 2.2; differences in factor endowments enable cost savings from fragmentation of production. For Norwegian industry, relocation strategies may also be a way of retaining or gaining market shares in an increasingly competitive market place.

Of all the firms in our sample, 81% state “saving production costs” as a reason for offshoring, often in combination with other reasons. The discovery of petroleum in the North Sea in the 1970s had a huge impact on the Norwegian industry. The revenues from the oil and gas sector to the Norwegian government have made Norway to one of the wealthiest nations in the world, enabling the government to increase its spending. This has, among other, affected Norwegian industry through higher wages due to relatively low unemployment and due to competition of labour from the public sector and a growing service sector. Figure 4.6 shows the average monthly labour cost in manufacturing in year 2005 for some countries. We see that Norway has the highest average wage cost per employee in the aggregated industry, while the Eastern European and Asian countries ranges in the lower end of the graph.

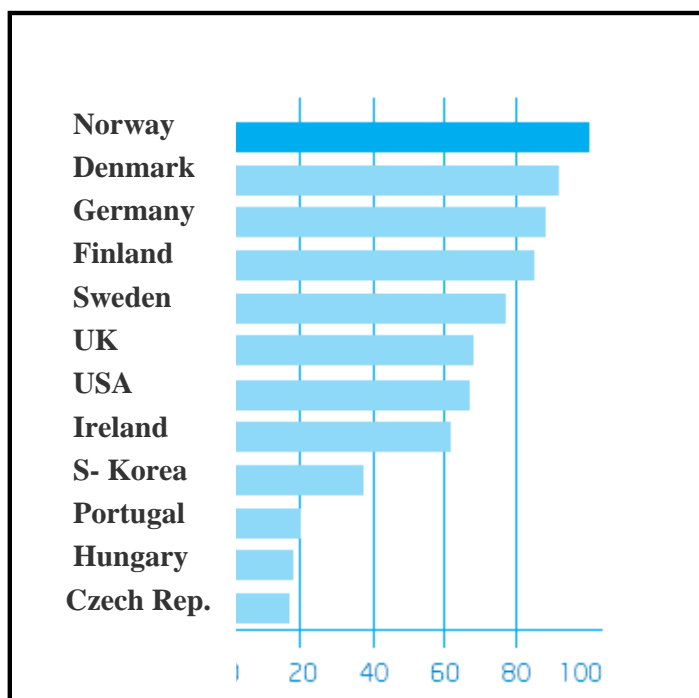
The wage numbers do not, however, include differences in productivity which are central in gaining insight to unit labour cost<sup>43</sup>. Higher wages may as well reflect high productivity. I have not added productivity since aggregate numbers may circumscribe differences in productivity between industrial sectors, between firms and stages of production, as differences in technology may differ substantially. Still, the differences in labour costs are significant and support the desire to offshore production. It is also important to note that, despite the high average wage costs in Norway, the cost of educated labour in Norway is also lower than in several other western countries<sup>44</sup>.

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<sup>43</sup> Unit labour cost reflects differences in productivity as well as wage level.

<sup>44</sup> Noreng (1994). It is important to note that the trend in education has shifted and less people choose education within engineering and nature sciences. Additionally, relatively low

FIGURE 4.6 WAGE COST FOR INDUSTRY WORKERS 2005, NORWAY=100



Source: NHO, "Norge i verden"

The ship building industry in Norway, which is the industry with a higher share of responses towards saving costs, faces strong competition in building standardized ships due to a high domestic cost level. Most of the remaining ship builders in Norway therefore have specialized their ship yards, typically on purpose-built ships that require technical experience and managerial expertise, such as transport of gas<sup>45</sup> and chemicals, but also cruise vessels (Hammer, 2000). Production of ship may require machinery and training which can be expensive to implement. In addition, it may be that the transaction costs are high due to asset specificity if they use arm-length contracts. Aker Yard, as an example, uses in-house offshoring of hull to Romania.

Saving costs is the main reason why the offshore industry offshore, partly due to competition from low cost countries. The Norwegian offshore industry is reliant on a strong home market with demand for more specialized equipment adapted to the

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unemployment in Norway makes labour a scarce resource (see for example NHO, Norge i verden)

<sup>45</sup> Here, Norway controls approximately 1/4 of the world market.

Norwegian continental shelf, since most of the sale has been to oil companies operating in the North Sea<sup>46</sup>. It is expected that the exploration in the oil and gas industry will be higher in other countries than Norway going forward, countries which have other requirements than Norway<sup>47</sup>. Thus, the Norwegian offshore industry must be prepared for shifts in the demand. Aker Kværner has for example emphasized their expertise in concrete technology and its potential use in the future LNG facilities abroad. The expertise within Kværner in building large structures in concrete comes from the construction of large oil platforms made by concrete on the Norwegian shelf in the early 1980s<sup>48</sup>.

Production of textiles and furniture are typically unskilled labour intensive industries with large potential gains from placing production in low cost locations. The high costs of labour in Norway, as shown by figure 4.6, compared to countries with high shares of unskilled labour, such as China, makes offshoring likely in the Norwegian textile industry. In 2006, the wage increase in the Norwegian industry was expected to be around 10,000 Norwegian kroner for an industry worker. That is approximately the same as the annual salary for an industry worker in China<sup>49</sup>, exemplifying the challenges the unskilled labour intensive industry faces in Norway.

One way of reducing competition is to produce niche products. Specialization, or making the products unique, allows firms to charge a higher price which is more compatible with the cost level in Norway<sup>50</sup>. The demand for knowledge or competencies in the production increases and many companies choose to produce niche products rather than standardized goods.

The prediction that factor cost differentials promote vertical investments seems to fit well with the Norwegian industry. The high costs of unskilled labour in Norway force firms to relocate the low skilled labour intensive production processes and take advantage of the comparative advantages of high educated labour and skills.

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<sup>46</sup> Oljeindustrienes landsforening, Kon-Kraft (2002)

<sup>47</sup> See footnote 43

<sup>48</sup> Bjørndal, A. (Januar 2007)

<sup>49</sup> NHO, "Norge i verden"

<sup>50</sup> See footnote 46

### 4.3.3 Access to new markets

*“The emergence of China, India, and the former communist-bloc countries implies that the greater part of the earth’s population is now engaged, at least potentially, in the global economy. There are no historical antecedents for this development.”*

*- Ben Bernanke, August 25, 2006.*

Access to markets in Eastern Europe, increased the additional customer base with 75 million new potential customers. If we include Bulgaria, Romania and Turkey, the number reaches 170 million new potential customers. These numbers are high, but adding the potential gain in customer base from China, India and other emerging economies, these numbers increase substantially. To take advantage in this growth, companies may relocate downstream stages of production, or duplicate all the stages of production, into these growing markets. The firms that responded “closeness to markets” and “expansion” may have this in mind when relocating production processes, most prominent within machinery, electronics and metal.

The creation of the common market in Europe has not only increased the size of the market place, it has also reduced trade barriers. This has made Europe more attractive for foreign investments from the US and Japan in the 1990s<sup>51</sup>. China joined WTO in December 2001; giving the country access to important markets around the world, facilitating the inflow and outflow of investments to China.

As can be seen in figure 4.4 and 4.5, several firms choose “expansion” as a reason for their offshoring activity. This is particularly true within the furniture, transportation and electronics industry. But 71% of the firms claiming expansion as a reason for offshoring also mark “saving production cost” as important. Hence, firms may use offshoring strategies to save costs but also possibly to evaluate expansion in the future. Vertical investments can thus be serving as a platform for horizontal investments into new markets when the firm collects knowledge and experience.

China has ambitions to become the world leader within ship building in year 2015, and have made considerable investments in new, modern ship building yards. This has attracted a large amount of Norwegian ship equipment suppliers<sup>52</sup> searching for

<sup>51</sup> Barba Navaretti and Venables (2004)

<sup>52</sup> DnB Nor, [https://www.dnbnor.no/bedrift/store/nyheter/kurs\\_mot\\_kina.html](https://www.dnbnor.no/bedrift/store/nyheter/kurs_mot_kina.html)



new markets for their products. That many firms within electronics produces equipment for ship, may explain why electronics has relatively high responses towards “expansion” and “closeness to markets”. These suppliers may duplicate production into China to gain closeness to the growing ship building industry.

Firms may have additional gains than factor cost differentials from relocating their production. Some industries may gain from being close to markets where the research and development intensity in their field is high in order to adapt to changes in technology and demand. Figure 4.9 shows the research and development intensity of production in the OECD countries in the period 1987-89, where electronics and most transportation equipment fall under the category high (medium-high) R&D intensive. As noted in figure 4.3, showing the geographical distribution over industries, transportation industry mainly choose locations in the west and as noted this may be due to the R&D intensity. The same holds for companies within electronics, which needs to adapt to changes in demand and request from customers. This supports the theory that firms may gain from being close to markets where the research and development intensity of their products is higher.

**TABLE 4.3 THE R&D INTENSITY OF PRODUCTION IN THE OECD, 1987-89**

	R&D/ Production				R&D/ Production
<b>High</b>			<b>Medium-high</b>		
Aerospace	20,2		Instruments		4,8
Computers	12,4		Motor vehicles		3,5
Electronics	10,8		Chemicals		3,4
Pharmaceuticals	10,3		Electrical machinery		3,2
<b>Medium-low</b>			<b>Low</b>		
Machinery	2,1		Ferrous metals		0,7
Other transport equipment	1,9		Fabricated metals		0,6
Shipbuilding	1,4		Food, drink and tobacco		0,3
Petroleum refining	1,1		Paper and printing		0,2
Stone, clay and glass	1		Textiles and clothing		0,2
Other manufacturing	1		Wood and furniture		0,1
Rubber and plastics	0,9				
Non-ferrous metals					

Source: Sheehan (1996)

#### 4.4 THE COST OF DISINTEGRATING STAGES OF PRODUCTION

As noted by Barba Navaretti and Venables (2004), “transaction costs are related to inefficiencies in co-ordinating production activities through the market system in a world of imperfect information” (pg 100). Threshold costs, or transaction costs, arise in each stage of contracting; finding a partner, judging his truthfulness and trustworthiness, set up a contract, re-negotiations, set up channels of communication, controlling the supplier, etc, and it is likely that operating abroad increases these issues. (Barba Navaretti and Venables, 2004)

It is difficult to directly measure the transaction costs a firm may face, but as explained in section 2.3.2, there is assumed to be a relationship between the size of the firm and transaction costs. A smaller firm may have problems in becoming international due to small scales of production and large fixed co-ordination cost compared to volume, in addition to bounded rationality, opportunism and uncertainty. Theory predicts that larger firms have lower transaction costs than smaller firms, which may imply that smaller firms have less offshoring than larger firms. One question we can ask is what the difference between a small and a large firm is. Nooteboom (1992) uses the Dutch notation, firms being small when they have less than 10 employees, medium sized when they have between 10 and 100 employees and big if they have more than 100 employees.

Norway has few large companies. Only around 5 percent of all the Norwegian companies have more than 100 employees. The other are often characterized as small or medium sized enterprises (SME)<sup>53</sup>. 79% of the companies in the Norwegian industry have less than 20 employees, and still SME's employs around half of the total employees in the industry and creates 40% of the production value in the industry. (Ministry of foreign affairs, 2000)<sup>54</sup>

As we can see from table 4.4 below, our sample is also dominated by SME's, with 90% of the firms having less than 100 employees.

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<sup>53</sup> Following the European Unions measures of SME, small firms are defined as having less than 50 employees and medium sized firms have fewer employees than 250.

<sup>54</sup> <http://odin.dep.no/odinarkiv/norsk/ud/2002/annet/032091-991443/dok-nn.html>

43% of the firms that fall into the category above 100 employees have offshoring. But surprisingly, 42% of the firms that fall into the category less than 10 employees have offshoring. The latter percentage is high, and may imply that the transaction costs faced by the smaller firms are not higher than the benefits from relocating production. It may also be that diffusion of information and communication technology has reduced the costs of identifying a suitable partner, but also due to easier communication with the supplier and supervision with the production processes. In addition, more flexible production equipment and increased market thickness may reduce the transaction cost; particularly it may reduce the hold-up problem discussed in section 2.4.

**TABLE 4.4 EMPLOYEES**

Employees	Number of firms	Number of firms (%)	Number of firms	Firms with offshoring (each category=100%)
<b>&gt;100</b>	88	10 %	38	43 %
<b>10-100</b>	233	65 %	82	35 %
<b>&lt;10</b>	35	25 %	15	42 %
<b>Total</b>	356	100 %	135	-

It is important to note that it may be that the firms are small because they already have relocated production or because they have invested in more productive machinery, reducing the number of employees working in the Norwegian firm.

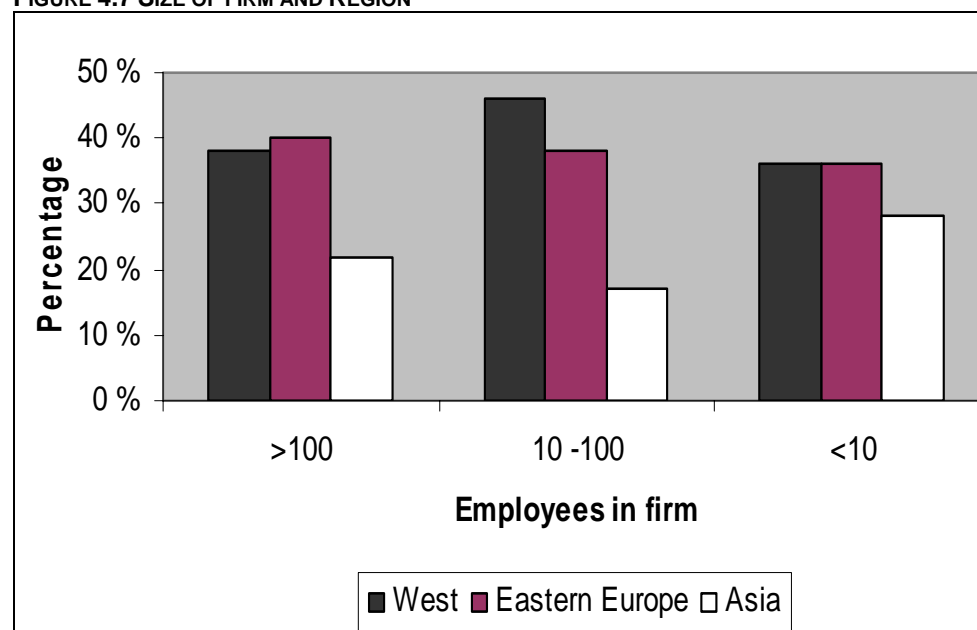
Another explanation for the relationship between the smaller size of the firm and offshoring activity may be that smaller firms can act collectively to reap some of the scale benefits by using production networks. Production networks connect a range of alliance partners with different types of organizational forms; company subsidiaries, independent contractors, sometimes competitors, vendors and logistics providers with the goal of producing and delivering complex and large scale projects<sup>55</sup>. Smaller firms can avoid their disadvantages of small scale of production and high fixed costs by co-operating with other firms in logistics, R&D and sharing fixed plant costs if they

<sup>55</sup> Goldsborough, B., 2005

are located at the same site. As we will see in the next section, the smaller firm in our sample offshore more often by using production networks.

Figure 4.7 shows the relationship between the size of the firm and the region to which it offshore. From the theory of service link cost in section 2.3.2, we may expect that a smaller company have smaller transaction necessities than a large firm, thus that the unit cost of coordination is high. Surprisingly, smaller companies seem to be more inclined to offshore to Asia than larger companies (as share of number of offshoring firm in each group). The textile industry is typically dominated by small firms and a high share uses the factor cost advantage by moving production to Asia, as can be seen from graph 4.3. The small firms undertaking activities in Asia must find it profitable to do so, thus the benefits from lower marginal costs must be greater than the co-ordination that arises from offshoring.

**FIGURE 4.7 SIZE OF FIRM AND REGION**

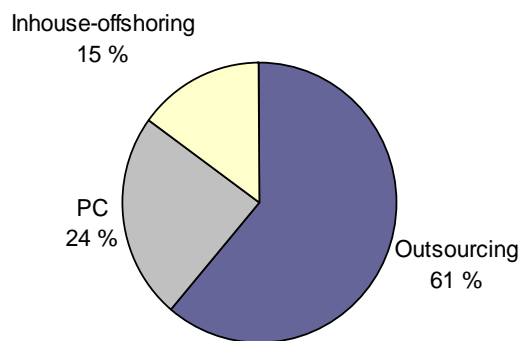


**Note:** Firms may offshore to more than one region. Each category of employees represents 100%.

#### 4.5 ORGANIZATIONAL FORM AND OFFSHORING

The firms with offshoring in our sample can choose different organizational form when they reallocate their stages of production; the use of arm-length contracts, in-house offshoring or production co-operation. The firms in our sample, as can be seen in figure 4.8 mainly choose the former variant - outsourcing.

**FIGURE 4.8 ORGANIZATIONAL FORMS**



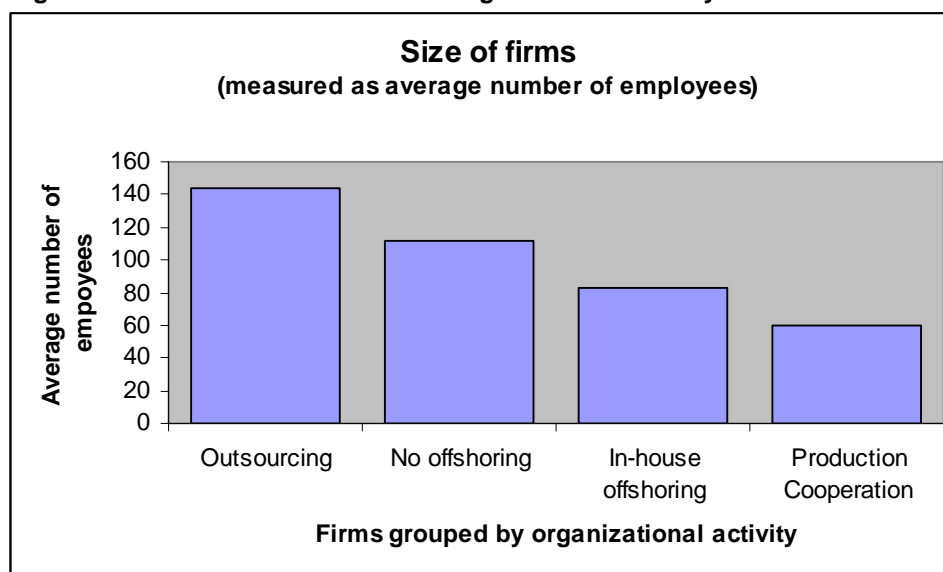
**Note:** The figures represent number of firms that has responded this option in the survey. A firm may choose more than one option.

The first modern multinational companies, arising in the 1880s and 1890s, were in general large, mature and integrated firms (Chandler 1986). They, and their descendants, have reaped substantial economies of scale in production, R&D and other areas. They were better equipped to communicate efficiently internationally, have more efficient transportation and the exchange of production and market information (Oviatt and MacDougall, 2005). Furthermore, market power in oligopolistic industries has been highlighted as a source of MNE advantages (Dunning 1981). Also, as previously explained in the theoretical section, transaction cost is assumed to be related to the size of a firm. Thus we may expect that the

smaller firms in our sample choose to keep production domestic. This may be the reason that MNE's in general are larger companies than national firms<sup>56</sup>.

Furthermore firms that choose to organize their activity through in-house offshoring are expected to be larger than the firms that operate at home. Figure 4.9 show the average size of firms that choose to organize their vertical activity using outsourcing, in-house offshoring, production cooperation or firms that choose to keep production processes domestic.

**Figure 4.9 Size of firms and chose of organizational activity**



Interestingly, the average number of employees in companies that operate under in-house offshoring is relatively low for being multinational enterprises (MNE). However, the number of firms in our sample that reports in-house offshoring are relatively low, which may imply that these numbers are biased. In addition, it may be that size is both a cause and an explanation for MNE's competitive advantage. That is, bigger MNE's may be a concomitant, not a cause of other more elementary sources of comparative advantage.

Changes in economic, technological and social conditions as explained in the introduction has increased the speed of international communication and transportation and probably also reduced the transaction costs (Porter, 1990). These

<sup>56</sup> Barba Navaretti and Venables, 2004

improvements may benefit the smaller firms, thus may explain why the average size of the firms of the multinationals in our sample is relatively low compared to those that choose offshoring. (Oviatt and MacDougall, 2005)

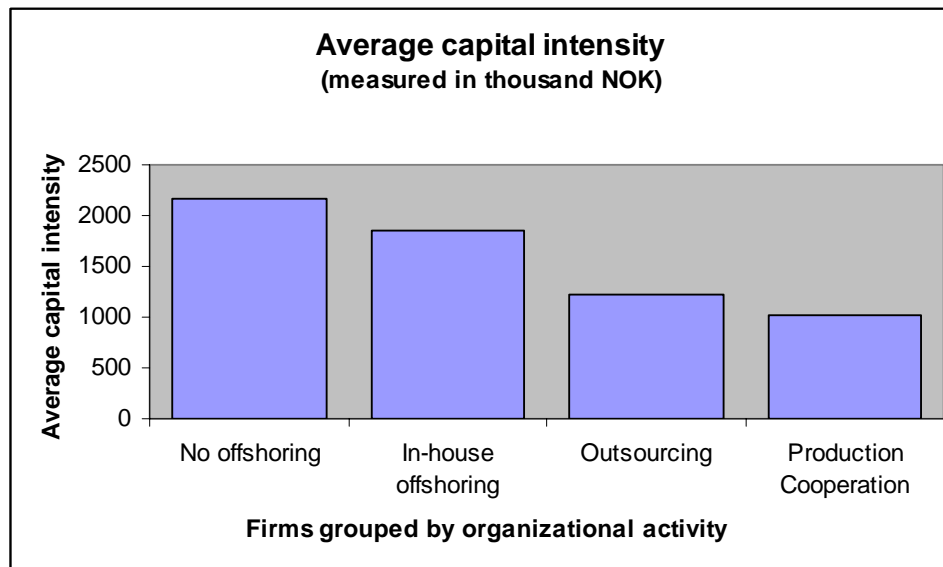
The choice of organizational form is dependent on the type of good that is traded, the frictions in the market and the asset specificity, where it is assumed that goods are more easily traded within the boundaries of the company. Empirical data confirms that capital intensive goods are traded more often within the boundaries of the firm. Antràs (2003) argues that transaction cost and the hold-up problem are increasing with the capital intensity of the imported good.

We do not have any measure on the capital intensity of the stages of production that may be subject to offshoring. A firm that on average is relatively capital intensive may offshore stages of production that are relatively more labour intensive. Still, the measure of a firm's capital intensity may give an indication of the types of goods that are traded, thus I have chosen to include this measure. These numbers must be interpreted with care. Capital intensity is calculated as:

$$\text{Capital intensity} = \frac{K}{L} = \frac{\text{Fixed assets}}{\text{Employees}}$$

Following Antràs (2003) we should expect to see that more capital intensive firms, if this can be transferred to traded intermediate goods, are more likely to use in-house offshoring than low capital intensive firms. This is because production of capital intensive goods requires more machinery which may increase the asset specificity and the hold-up problem. Indeed, as we may see from figure 4.10, the firms that choose this organizational form have higher average capital intensity than firms that choose other ways to organize.

**Figure 4.10 Average capital intensity**



Productivity may be used as a measure of the ability to undertake larger fixed costs, as proposed by Helpman et al. (2004). He assumes that the fixed costs of integration are higher than the cost of outsourcing. Taking into account capital intensity and productivity, his model predicts that the most productive firms are more likely to become a multinational firm (that is, use in-house offshoring), firms that are a little less productive outsource, firms that have low productivity keeps production in the home country and the least productive firms exit the market. The fixed set-up costs associated with internalization are higher than the set-up costs associated with outsourcing, and following this, only the more productive firms are able to undertake these costs.

Following this theory we should expect to see that the more productive firms use in-house offshoring, and that the least productive proceed with domestic production.

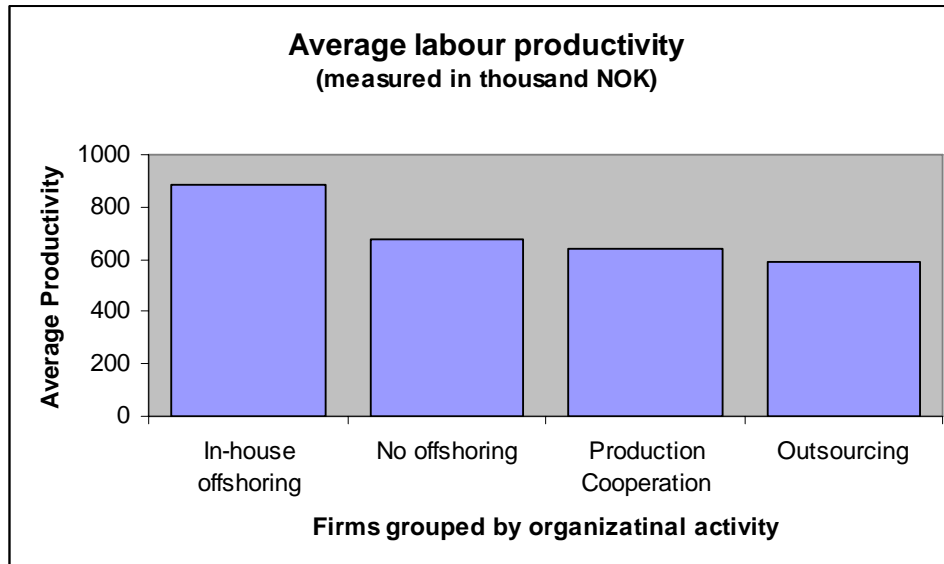
I have measure labour productivity as:



$$\text{Productivity} = \frac{\text{Total income} - \text{input (such as raw material and other goods used in production)}}{\text{Number of employees}}$$

Figure 4.11 show the relationship between average labour productivity and organizational activity.

**Figure 4.11 Average labour productivity**



We see that the calculations from our sample fit well with this theory. The firms that have chosen to use in-house offshoring have on average higher productivity than firms that choose to outsource and to keep production at home. The difference between outsourcing and no offshoring is small, which could be because some Norwegian companies have advantage in producing in Norway. For example they could be suppliers to national firms or they may be dependent on domestic assets such as specific skills or resources. These firms may still be productive. It may also be that firms become more productive from reallocating production abroad. Thus, it may be difficult to determine the causal relationship.

The firms that have chosen production co-operation may contain firms that partly own factories, wholly own plants or that use external suppliers, thus it is difficult to generalize based upon the results in the figure 4.9-4.11.

#### 4.6 SUMMARY

The determinants that trigger Norwegian firms to offshore production are many; some determinants are dependent on type of industry and firm, while others are determined by differences between countries. The determinants related to differences between countries are variations between production costs at home and abroad and differences in the markets at home and abroad. The determinants that are dependent on firm and industry characteristics are in particular differences in factors used in production, the type of good produced, if the production requires closeness to the customers or if the firm has the potential to expand or not.

Most of the technology industry faces fierce competition in the markets they compete in, and it is difficult to keep the production costs low as the costs of unskilled labour in Norway is relatively high. This has led to increased specialization, i.e. production of niche goods, reducing the vulnerability with regards to production costs. In addition to specialization of finished goods, the firms also divide stages of production into production blocks, where each block may use one factor more intensively. These blocks may be subject to relocations following patterns of comparative advantage such as moving labour intensive stages of production to countries abundant in labour. Relocation of production blocks may be a strategy to save production costs, following from differences in factor prices. It may additionally be a strategy to get access to specialized equipment or services, to be close to customers, to take advantage of R&D in other locations or to take advantage of a growing market.

The descriptive analysis shows that 39% of the firm offshore production. The furniture, textile, machinery and transportation equipment industries have offshoring percentages above 45%. This relatively high occurrence of offshoring may be explained by the relatively high labour intensity within textile, offshore, machinery and transport equipment industries. There are 81% of the respondents that mention saving production costs as a reason for offshoring. Thus it is adjacent to assume that firms are exploiting differences in factor costs to save production costs. A majority of the firms that relocate production choose to relocate their production in low cost locations, particularly Poland and China, where the costs of unskilled labour are relatively low.

Access to new markets may be an additional reason for offshoring. An increase in the potential customer base and the likely growth in income per capita from the emerging markets in Asia and Eastern Europe may attract companies to place downstream stages of production in these markets. The industries machinery, metal and metal goods, in addition to electronics have given reasons for offshoring that may imply that access to markets is important. It may also be that these firms need to be close to their customers in able to keep up with changes in demand and to maintain their R&D activity by being close to R&D intensive countries. Furthermore, a firm may have several strategies at hand when moving abroad. It can be that a firm that relocate production in order to save costs in the imminent future, also in the long run is interested in expanding into new markets, or it may wish to gain closeness to markets through mergers or acquisitions, either by duplicating stages of production, duplicating whole activities or by moving headquarters.

The costs arising from disintegrating stages of production, such as transportation costs, co-ordination costs and transaction costs affect the decision to offshore production. Theory explains that firms of bigger size face relatively less transaction costs than smaller firms. By grouping the firms by size and viewing their offshoring activity, we may be able to see whether our findings are consistent with theory. The results are not clear from the TBL survey as also smaller firms have high shares off offshoring.

There may also be costs that arise due to co-ordination. I reviewed the relationship between region and the size of a firm. One could expect that smaller firms would have lower shares of offshoring to Asian countries, due to distance and likely increased transaction costs. However, the data from TBL did not indicate such a relationship.

A firm may choose to relocate stages of production using in-house offshoring or it may choose to use the external market mechanism to allocate resources. Most of the firms in our sample choose the latter. There seems to be a relationship between a firm's capital intensity and in-house offshoring. It is also assumed that firms that choose in-house offshoring are more productive. Reviewing average productivity

within the groups that choose different organizational forms, we find that the productivity is higher within the group of firms that use in-house offshoring.

## 5.0

### CONCLUSION

The aim of this thesis has been to analyse the determinants that trigger Norwegian firms to offshore and how these firms choose to organize their offshoring activities; through in-house offshoring or outsourcing. Surveying the determinants for offshoring of the Norwegian industry is important for understanding the increasing verticality in trade, and it can be a starting point of analyzing which industries that may be more affected, and the consequences this could have for Norway.

The findings of this thesis are that differences in factor costs is the main reason for offshoring production in the Norwegian industry, and that the benefits from doing so are higher than the co-ordination costs that arise from disintegrating stages of production. The choice of organizational form seems to be dependent on the capital intensity of the final goods produced and on the productivity of the firms. The results of this survey indicate that there does not seem to be less offshoring activity among the smaller firms, despite the transactions costs related to offshoring.

Regardless of the large number of international articles and economic papers on the topic of offshoring, there are a limited number of empirical analyses on offshoring in the Norwegian industry. The problem may be lack of data, particularly longitudinal data which may give more insight into how the economic environment affects the decision to offshore production. This, in my opinion, should be requested for the future debate about the Norwegian industry.

## A APPENDIX

### A1 Questionnaire

#### Vedlegg I



#### SVARSKJEMA - TBLs uteproduksjonsundersøkelse

Returneres pr telefaks til TBL v/ Egil Sundet. Telefaksnummer 22 59 00 01.

1. Navn på bedrift ..... Omsetning i 2000: .....mill kr.

2. Navn på kontaktperson .....  
Direkte tlf ..... E-post .....

3. Hvor stor andel av bedriftens omsetning kom fra uteproduksjon (leieproduksjon eL) i 2000. ....%

4. Angi land hvor bedriften har uteproduksjon i dag .....

5. Hva slags uteproduksjon er det snakk om, er den supplement eller erstatning til prod. i Norge?

Sett kun ett kryss

Supplement

Erstatning

Ren leieproduksjon

☐
☐

Produksjons samarbeid

☐
☐

Egen etablering

☐
☐

6. Hva var hovedgrunnen til uteproduksjon? Kan sette flere kryss.

Billigere produksjon ☐ Ekspansjon ☐ Nærhet til marked ☐ Utenlandske eiere krever det ☐

Annet: ..... Annet: .....

7. Hvilke erfaringer har dere i forhold til kvalitet, pris, leveringstid mv?

God erfaring

Dårlig erfaring

Eventuelle kommentarer

Kvalitet

☐
☐

Pris

☐
☐

Leveringstid

☐
☐

Annet .....

8. Hvilke planer har bedriften mht. uteproduksjon i de neste fem årene?

.....  
.....

9. Har dere flyttet ut/etablert ny produksjon i utlandet de siste fem årene? Ja ☐ Nei ☐

Angi omsetning flyttet ..... mill kr.

10. Har dere skiftet fra norske til utenlandske underleverandører i de siste fem årene?

Hvis ja, hvilke erfaringer har dere mht. kvalitet, pris, leveringstid mv?

God erfaring

Dårlig erfaring

Eventuelle kommentarer

Kvalitet

☐
☐

Pris

☐
☐

Leveringstid

☐
☐

Annet .....

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